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Cahaba River Wastewater Facilities Jefferson, Shelby and St. Clair Counties, Alabama. Appendices

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345 Courtland Street, NE
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Environmental Impact Statement

Cahaba River Wastewater Facilities Jefferson, Shelby and St. Clair Counties, Alabama
Project No. C010269-01

Appendices

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The DRAFT Environmental Impact Statement (EPA 904/9-78-009) was prepared in response to the ~~pro~~proposed action of awarding grant funds to Jefferson County Commission, Alabama for the purpose of developing wastewater treatment facilities to service the upper portion of the Cahaba River Basin. The project consists of modifications to four existing treatment facilities. It is proposed that the Patton Creek Plant be abandoned; the Cahaba Plant be upgraded and expanded to 12 MGD with ultimate expansion to 16 MGS; the Leeds Plant be expanded to 1.5 MGD and the Trussville Plant be expanded to 1.25 MGD. It is also proposed that interceptor lines be extended in the Basin to provide service to existing population centers.

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APPENDIX I

ENVIRONMENTAL SETTING

i.a

TABLE OF CONTENTS

APPENDIX I. ENVIRONMENTAL SETTING

	Page
PART A. NATURAL ENVIRONMENT	
Discussion Papers	
Tables	AI-1
Figures	AI-26
PART B. MAN-MADE ENVIRONMENT	
Discussion Papers	
Tables	AI-66
Figures	AI-87

PART A. NATURAL ENVIRONMENT

DISCUSSION PAPERS

	Page
SOILS DESCRIPTIONS	AI-1
BEDROCK-VEGETATIONAL RELATIONSHIPS	AI-6
SPECIES OF ECONOMIC IMPORTANCE	AI-8
FOREST COVER TYPES	AI-10
PHYSICAL CHARACTERISTICS OF THE CAHABA RIVER	AI-19

PART A. NATURAL ENVIRONMENT

LIST OF TABLES

Table		Page
I-1	Pollution Sources Along The Upper Cahaba River	AI-24 & AI-25
I-2	Summary Of Cahaba River Fish Kills	AI-26
AI-1	Monthly Temperature Ranges	AI-26a
AI-2	Ambient Air Quality Standards Of Alabama	AI-27
AI-3	1975 Air Pollutant Concentrations In The Birmingham Area	AI-28
AI-4	Cahaba River Basin Geologic Formations	AI-29 to AI-31
AI-5	General Engineering Characteristics Of Rocks In The Greater Birmingham Area	AI-32 & AI-33
AI-6	Aquifer Characteristics	AI-34 to AI-36
AI-7	Amphibians And Reptiles Reported In The Upper Cahaba River Drainage Basin (Mount 1975)	AI-37 to AI-40
AI-8	Rare and Endangered Species Of The Upper Cahaba River Basin	AI-41
AI-9	Concentrations Of Major Water Quality Parameters In The Study Area	AI-42 to AI-46
AI-10	Water Use Classifications	AI-47 to AI-50
AI-11	Probable Aquatic Plants Of The Cahaba River	AI-51 and AI-52
AI-12	A List Of Invertebrates Collected From Twelve Sections Of The Upper Cahaba River In Sept. 1976	AI-53 to AI-57
AI-13	Mussels From The Upper Cahaba River	AI-58
AI-14	Locations And Descriptions Of Stations, Cahabe River Sub-Basin	AI-59
AI-15	Pollution Sensitive Forms - Macroscopic Invertebrate Organisms - Cahabe River Basin (USDI 1967)	AI-60

PART A. NATURAL ENVIRONMENT (Cont'd)

LIST OF TABLES

Table		Page
AI-16	Pollution Tolerant Forms - Macroscopic Invertebrate Organisms - Cahaba River Basin (USDI 1967)	AI-61
AI-17	Fishes Of The Cahaba River	AI-62 to AI-64
AI-18	Summary Of Cahaba River Fish Kills	AI-65

PART A. NATURAL ENVIRONMENT

LIST OF FIGURES

Figure		Following Page
1	Diagrammatic Map Of Cahaba River	AI-19
AI-1	Seasonal Wind Roses For The Greater Birmingham Area	AI-65
AI-2	Air Quality Monitoring Locations And Pollution Sources	AI-65
AI-3	Typical Noise Patterns	AI-65
AI-4	Topographic Features	AI-65
AI-5	Geology	AI-65
AI-6	Soils Limitations On Wastewater Disposal	AI-65
AI-7	Land Cover Map	AI-65
AI-8	Drainage Basins	AI-65

PART B. MAN-MADE ENVIRONMENT

DISCUSSION PAPERS

Page

POPULATION AND LAND USE CHARACTERISTICS AI-66

EMPLOYMENT CHARACTERISTICS AI-71

WATER SUPPLY STUDY AI-74

COMMUNITY SERVICES AND FACILITIES AI-76

BIRMINGHAM WATER WORKS BOARD RATE SCHEDULE AI-82

MAJOR REVENUE PROVISIONS OF THE 1977 JEFFERSON COUNTY SEWER ORDINANCE AI-84

PART B. MAN-MADE ENVIRONMENT

LIST OF TABLES

Table		Page
AI-19	Comparison Of Employment By Major Industrial Category For The United States, Alabama And The BRPC Region 1960-1970	AI-87
AI-20	County Employment Characteristics 1970	AI-88
AI-21	Employment Characteristics For Municipalities In The Study Area 1970	AI-89
AI-22	Income Comparison 1960-1970	AI-90
AI-23	Income Characteristics For Municipalities In The Study Area 1970	AI-91
AI-24	Labor Force Characteristics	AI-92
AI-25	Labor Force Characteristics For Municipalities In The Study Area	AI-93
AI-26	Number Of Establishments 1973	AI-94
AI-27	Analysis Of Coal Seams In The Cahaba Coal Field	AI-95
AI-28	Privately Owned Wastewater Collection And Treatment Systems	AI-96 and AI-97
AI-29	Water Quality At Shades Mountain Filter Plant	AI-98
AI-30	Production At Shades Mountain Filter Plant	AI-99
AI-31	Summary Of Supply And Treatment Capacities Of Existing And Proposed Facilities	AI-100
AI-32	Summary Of Supply And Treatment Requirements	AI-101
AI-33	Study Area Property Tax Rates Per $100 Assessed Value	AI-102

PART B. MAN-MADE ENVIRONMENT

LIST OF FIGURES

Figure		Following Page
AI- 9	Mineral Extraction	AI-102
AI-10	Flow Diagram of the Patton Creek WWTP	AI-102
AI-11	Flow Diagram of the Cahaba WWTP	AI-102
AI-12	Flow Diagram of the Leeds WWTP	AI-102
AI-13	Flow Diagram of the Trussville WWTP	AI-102

PART A. NATURAL ENVIRONMENT

SOILS DESCRIPTIONS

HARTSELLS LINKER GROUP

Hartsells soils are moderately deep, 20" to 40" thick, well drained, and are on upland ridges. Slopes range from 2 to 25 percent. They typically have brownish, loamy surface layers over brownish, loamy subsoils. Hartsells soils are underlain by sandstone. Permeability is moderate (0.6 - 2 inches per hour) and infiltration and runoff rates are medium. These soils have no flooding or high water table hazards.

Linker soils are moderately deep, well drained, and are on uplands. Slopes range from 1 to 20 percent. They typically have brownish, loamy surface layers over reddish, loamy subsoils and are underlain by sandstone.

TOWNLEY ENDERS ALBERTSVILLE GROUP

Townley soils are moderately deep (20 to 30 inches thick), well drained, and are on uplands. Slopes range from 2 to 45 percent. They typically have brownish, loamy surface layers over reddish clayey subsoils. Townley soils typically are silt loams underlain by level bedded, consolidated shale. Permeability is slow (less than 0.2 inches per hour). These soils are well drained, with no seasonal water table or flood hazard. Runoff and infiltration rates are medium.

Enders soils are deep, well drained, and are on uplands. Slopes range from 2 to 45 percent. They typically have brownish, gravelly, loamy surface layers over reddish, clayey subsoils that have grayish and brownish mottles in the lower part.

Albertsville soils are deep, well drained, and are on uplands. Slopes range from 2 to 15 percent. They typically have brownish, loamy surface layers over yellowish and brownish, clayey subsoils. Albertsville soils are underlain by shale.

COLBERT TALBOTT DOWELLTON GROUP

Colbert soils are deep, moderately well to somewhat poorly drained, and are on uplands. Slopes range from 1 to 20 percent. They typically have brownish, loamy, surface layers over brownish, clayey subsoils. Colbert soils are underlain by limestone.

Talbott soils are moderately deep, well drained, and are on uplands. Slopes range from 2 to 25 percent. They typically have brownish, loamy, surface layers over clayey subsoils that are reddish in the upper part and brownish in the lower part.

HECTOR MONTEVALLO GROUP

Hector soils are shallow, less than 20" thick, well drained, and are primarily found on uplands and steep ridge sides. Slopes range from 2 to 60 percent. They typically have brownish, gravelly, loamy surface layers over brownish, loamy subsoils. Hector soils are underlain by sandstone. Hector soils have moderately rapid permeability (2 - 6 inches per hour), medium infiltration and medium runoff rates. These soils have no flooding or high water table hazards.

Montevallo soils are shallow (less than 20" thick) well drained, and are found on uplands ridge sides and tops. Slopes range from 2 to 45 percent. They typically have grayish, shaly, loamy surface layers over brownish, shaly, and loamy subsurface layers and subsoils. These soils typically are silt loams underlain by level bedded shale. Permeability is moderate (0.6 - 2 inches per hour), infiltration is medium and runoff medium to rapid. They have no flooding or high water table hazards.

BODINE FULLERTON HECTOR GROUP

Bodine soils are deep, somewhat excessively drained, and are on uplands. Slopes range from 5 to 60 percent. They typically have brownish, cherty, and loamy surface and subsoil layers.

Fullerton soils are deep, well drained, and are on uplands. Slopes range from 2 to 40 percent. They typically have brownish, cherty, and loamy surface layers over reddish, cherty, and clayey subsoils.

Hector soils are shallow, less than 20" thick, well drained, and are primarily found on uplands and steep ridge sides. Slopes range from 2 to 60 percent. They typically have brownish, gravelly, loamy surface layers over brownish, loamy subsoils. Hector soils are underlain by sandstone. Hector soils have moderately rapid permeability (2 - 6 inches per hour), medium infiltration and medium runoff rates. These soils have no flooding or high water table hazards.

Slopes range from 2 to 40 percent. They typically have brownish, cherty, and loamy surface layers over reddish, cherty, and clayey subsoils.

Decatur soils are deep, well drained, and are on uplands. Slopes range from 1 to 25 percent. They typically have dark brownish, loamy upper subsoils over dark reddish, clayey lower subsoils.

Colbert soils are deep, moderately well to somewhat poorly drained, and are on uplands. Slopes range from 1 to 20 percent. They typically have brownish, loamy surface layers over brownish, clayey subsoils. Colbert soils are underlain by limestone.

BODINE HECTOR ASSOCIATION

Bodine soils are deep, somewhat excessively drained, and are on uplands. Slopes range from 5 to 60 percent. They typically have brownish, cherty, and loamy surface and subsoil layers.

Hector soils are shallow, less than 20" thick, well drained, and are primarily found on uplands and steep ridge sides. Slopes range from 2 to 60 percent. They typically have brownish, gravelly, loamy surface layers over brownish, loamy subsoils. Hector soils are underlain by sandstone. Hector soils have moderately rapid permeability (2 - 6 inches per hour), medium infiltration and medium runoff rates. These soils have no flooding or high water table hazards.

MINVALE BODINE FULLERTON ASSOCIATION

Minvale soils are deep, well drained, and are on uplands. Slopes range from 2 to 45 percent. They typically have brownish, cherty, and loamy surface layers over reddish, cherty, and loamy subsoils.

Bodine soils are deep, somewhat excessively drained, and are on uplands. Slopes range from 5 to 60 percent. They typically have brownish, cherty, and loamy surface and subsoil layers.

Fullerton soils are deep, well drained, and are on uplands. Slopes range from 2 to 40 percent. They typically have brownish, cherty, and loamy surface layers over reddish, cherty, and clayey subsoils.

HECTOR ROCKLAND, LIMESTONE ALLEN ASSOCIATION

Hector soils are shallow, less than 20" thick, well drained, and are primarily found on uplands and steep ridge sides. Slopes range from 2 to 60 percent. They typically have brownish, gravelly, loamy surface layers over brownish, loamy subsoils. Hector soils are underlain by sandstone. Hector soils have moderately rapid permeability (2 - 6 inches per hour), medium infiltration and medium runoff rates. These soils have no flooding or high water table hazards.

Rockland, limestone, is a land type that represents a large component of limestone exposed at the surface.

Allen soils are deep, well drained, and occupy upland positions. Slopes range from 2 to 40 percent. They typically have brownish, loamy surface layers over reddish, loamy subsoils.

MONTEVALLO TOWNLEY ASSOCIATION

Montevallo soils are shallow (less than 20" thick) well drained, and are found on uplands ridge sides and tops. Slopes range from 2 to 45 percent. They typically have grayish, shaly, loamy surface layers over brownish, shaly, and loamy subsurface layers and subsoils. These soils typically are silt loams underlain by level bedded shale. Permeability is moderate (0.6 - 2 inches per hour), infiltration is medium and runoff medium to rapid. They have no flooding or high water table hazards.

Townley soils are moderately deep (20 to 30 inches thick), well drained, and are on uplands. Slopes range from 2 to 45 percent. They typically have brownish, loamy surface layers over reddish clayey subsoils. Townley soils typically are silt loams underlain by level bedded, consolidated shale. Permeability is slow (less than 0.2 inches per hour). These soils are well drained, with no seasonal water table or flood hazard. Runoff and infiltration rates are medium.

DECATUR FULLERTON GROUP

Decatur soils are deep, well drained, and are on uplands. Slopes range from 1 to 25 percent. They typically have dark brownish, loamy surface layers and dark brownish, loamy upper subsoils over dark reddish, clayey lower subsoils.

Fullerton soils are deep, well drained, and are on uplands. Slopes range from 2 to 40 percent. They typically have brownish, cherty, and loamy surface layers over reddish, cherty, and clayey subsoils.

CHEWACLA CONGAREE LOBELVILLE LOCUST LEADVALE GROUP

Chewacla soils are deep, somewhat poorly drained, and occupy flood plain positions. Slopes are less than 2 percent. They typically have brownish, loamy surface and upper subsoil layers over grayish, loamy lower subsoils.

Lobelville soils are deep, moderately well drained, and occupy bottomland positions. Slopes are less than 3 percent. They typically have brownish, cherty, and loamy surface layers over cherty and loamy subsoils that are brownish in the upper part and grayish in the lower part.

Leadvale soils, 0 to 4 percent slopes. These soils have brown silt loam surface soil layers that are about 8 inches thick. The subsoil layers consist of a yellowish brown silt loam layer over a mottled silty clay loam fragipan. The underlying material is shale. These soils are poorly suited for the application of wastewater treatment plant effluent because they are moderately well drained, have moderately slow permeability (0.2 to 0.6 inches per hour), and have a seasonal water table.

LEADVALE SERIES

Leadvale soils, 0 to 4 percent slopes. These soils have brown silt loam surface soil layers that are about 8 inches thick. The subsoil layers consist of a yellowish brown silt loam layer over a mottled silty clay loam fragipan. The underlying material is shale. These soils are moderately well drained, have moderately slow permeability (0.2 to 0.6 inches per hour), and have a seasonally high water table.

CHEWACLA SERIES

Chewacla soils are deep, somewhat poorly drained, and occupy flood plain positions. Slopes are less than 2 percent. They typically have brownish, loamy surface and upper subsoil layers over grayish, loamy lower subsoils.

FULLERTON DECATUR COLBERT ASSOCIATION

Fullerton soils are deep, well drained, and are on uplands.

BEDROCK-VEGETATIONAL RELATIONSHIPS

With regard to forest site quality, sandstone derived sites differ little from shale derived sites on the same topographic positions and the same aspects and they will support the same plant communities. Crests and upper slope positions of sandstone-shale ridges are of poor site quality. They are inherently dry sites, soils are thin and erodable and on some of the more rugged ridge tops bare outcrops of sandstone are present. These sites are predominantly pine or pine and dry site tolerant hardwood areas. Common natural pine species include Shortleaf Pine, Virginia Pine and the "mountain variety" of Longleaf Pine. Common Hardwoods usually include Blackjack Oak, Chestnut Oak and Mockernut Hickory. Poor quality site conditions extend down the hills on the Southeast and Southwest facing slopes to lower slope positions. The best quality site conditions in sandstone and shale are found along the overflow areas of streams and branches which disect the ridges and also on the Northeasterly and Northwesterly facing slopes of upland sites. The best sites are usually occupied by natural stands of Hardwoods such as Chestnut Oak, White Oak, Mockernut and Pignut Hickory, Scarlet Oak and Post Oak from approximately upper slope position to mid slope position. Moist lower slopes contain such hardwood species as, Yellow-Poplar, White Oak, Sweetgum, Red, Maple and Pignut Hickory. Naturally occurring pine species of the best sandstone-shale sites include Loblolly Pine, Virginia Pine and Shortleaf Pine.

Loblolly Pine is usually considered to be a moist site tolerant species (in this study area) but it has been planted extensively in many plantations throughout the study area and may be found off of its natural sites.

Naturally occurring forest types on chert structural ridges differ little from those found on sandstone-shale ridges. The most important consideration is the fact that the Fort Payne Chert is highly resistant to weathering and thus soils are thin and unproductive and site quality is poorer than the sandstone-shale structural ridges. Dry site conditions persist further down slope than on sandstone-shale ridges. Basic species composition of stands will be much the same but dry site tolerant species will be found farther down slope and moist site tolerant species will be less in evidence than on sandstone-shale sites.

The Fort Payne Chert probably produces some of the poorest sites to be found in this study area.

The Cahaba Valley area, on the eastern edge of the study area, is composed of the Odenville, Newala and Longview Limestones and the Chepultepec, and Copper Ridge Dolomites. These are probably the best and potentially most productive forest sites in the study area. The limestone-dolomite region is dominated by agricultural and urban development and much of the forest cover that originally inhabited the area has long since been removed.

Slope gradients are not as steep as in the chert and sandstone-shale structural ridges. A slightly different plant community, which tends toward greater occupancy of available sites by hardwood species dominates here. Naturally occurring pine stands, due to the calcareous nature of the soils were not in the past as wide spread as in the other geologic areas. Today, much unproductive agricultural land has been planted in pine, mostly, Loblolly Pine. Under natural circumstances hardwood species would be more tolerant of calcareous soils than would be pine species.

Major differences in hardwood composition between limestone-dolomite and sandstone-shale, chert are the appearance of greater numbers of such species as Shargbark Hickory, Green Ash, Basswood, Beech, Hackberry and Water Oak.

SPECIES OF ECONOMIC IMPORTANCE

Sport hunting and trapping are important recreational pursuits in the project area. The following species are legally hunted.

Turkey - Gobblers only	Nov. 19 - Jan. 22
Deer - Bucks only	Nov. 19 - Jan. 22
Deer - Hunters choice	Jan. 19 - Jan. 22
Deer - Bow and Arrow	Oct. 15 - Jan. 22
Bobwhite Quail	Nov. 20 - Feb. 28
Rabbit	Oct. 15 - Feb. 28
Squirrel	Oct. 25 - Jan. 10
Raccoon and Opossum	Oct. 15 - Feb. 28
Beaver, Nutria, Groundhog	No closed season
Starlings, Crows, Blackbirds	No closed season
Fox and Bobcat	No closed season
Dove	Sept. 18 - Nov. 3 and Dec. 24 - Jan. 15
Woodcock	Nov. 28 - Jan. 31
Coot	Dec. 2 - Jan. 20
Duck	Dec. 2 - Jan. 20
Goose	Nov. 12 - Jan. 20

The following species are designated as furbearers and are trapped:

Bobcat	Nov. 20 - Feb. 20
Fox	Nov. 20 - Feb. 20
Mink	Nov. 20 - Feb. 20
Muskrat	Nov. 20 - Feb. 20
Nutria	Nov. 20 - Feb. 20

Opossum	Nov. 20 - Feb. 20
Otter	Nov. 20 - Feb. 20
Raccoon	Nov. 20 - Feb. 20
Skunk	Nov. 20 - Feb. 20
Weasel	Nov. 20 - Feb. 20
Beaver	No closed season

The following data collected on the Cahaba Wildlife Management Area over a seven year period illustrates the rate that the demand for deer hunting has increased over time.

Year	Man Days of Recreation	Deer Harvested
1969 - 1970	476	4
1970 - 1971	748	9
1971 - 1972	1,980	19
1972 - 1973	1,903	20
1973 - 1974	2,182	38
1974 - 1975	1,214	22
1975 - 1976	1,713	42

The economic damage to forests and agricultural crops as a result of a deer herd which exceeds the carrying capacity of its environment were discussed with Ralph Allen, Chief of Game Management. Hunter and land-owner opposition to Hunter Choice seasons in many areas has allowed for an undesirable increase in deer density in many areas.

FOREST COVER TYPES

Cover Types Symbol		S.A.F. Equivalents
P	Longleaf pine - shortleaf pine	70

Type Description

Pine make up 70 percent or more of the basal area of the overstory. Longleaf pine and shortleaf pine, in any combination, usually make up the bulk of the pine component. Loblolly pine and eastern redcedar occur sporadically. Virginia pine never occur. The most common hardwood associates are mockernut hickory, blackjack oak, post oak, and scarlet oak. Less common hardwood associates include southern red oak, sassafras, black cherry, red maple, black tupelo, flowering dogwood, and sourwood.

P	Mixed pines	75,80

Type Description

Pine makes up 70 percent or more of the basal area of the overstory. Longleaf, shortleaf, and Virginia pine, in any combination, usually make up the bulk of the pine component. Loblolly pine is a common associate. Eastern redcedar occurs sporadically. The most common hardwood associates are mockernut hickory, blackjack oak, and chestnut oak. Less common hardwood associates include pignut hickory, northern red oak, post oak, scarlet oak, southern red oak, white oak, sassafras, sweetgum, black cherry, eastern redbud, red maple, black tupelo, flowering dogwood and sourwood.

P	Loblolly pine (upland)	81

Type Description

Pine makes up 70 percent or more of the basal area of the overstory. Loblolly pine usually makes up the bulk of the pine component. Shortleaf pine and Virginia pine are common associates. Longleaf pine and eastern redcedar occur sporadically. The most common hardwood associates are chestnut oak, post oak, and white oak. Less common hardwood associates include mockernut hickory, pignut hickory, American beech, black oak, northern red oak, scarlet oak, southern red oak, yellow-poplar, sweetgum, black cherry, red maple, American basswood, flowering dogwood, and sourwood.

P	Shortleaf pine - loblolly pine	81

Type Description

Pine makes up 70 percent or more of the basal area of the overstory. Loblolly pine and shortleaf pine, in any combination, usually make up the bulk of the pine component. Virginia pine is a common associate. Eastern redcedar occurs sporadically. Longleaf pine does not occur. The most common hardwood associates are post oak and white oak. Less common hardwood associates include mockernut hickory, pignut hickory, black oak, blackjack oak, chestnut oak, scarlet oak, southern red oak, yellow-poplar, sassafras, sweetgum, black cherry, American holly, red maple, yellow buckeye, flowering dogwood, and sourwood.

P Loblolly pine - shortleaf pine 81

Type Description

Pine makes up 70 percent or more of the basal area of the overstory. Loblolly pine and shortleaf pine, in any combination, usually make up the bulk of the pine component. Longleaf pine, Virginia pine, and eastern redcedar occur sporadically. The most common hardwood associates are blackjack oak, post oak, southern red oak, and white oak. Less common hardwood associates include mockernut hickory, pignut hickory, shagbark hickory, black oak, northern red oak, scarlet oak, water oak, American elm, yellow-poplar, sweet-gum, black cherry, eastern redbud, red maple, black tupelo, flowering dogwood, sourwood, and green ash.

P Loblolly pine (drainage) 81

Type Description

Pine makes up 70 percent or more of the basal area of the overstory. Loblolly pine makes up the bulk of the pine component. The other pines and eastern redcedar occur sporadically. The most common hardwood associates are water oak, white oak, yellow-poplar, and sweetgum. Less common hardwood associates include pignut hickory, shagbark hickory, hazel alder, American beech, chestnut oak, northern red oak, southern red oak, black cherry, red maple, flowering dogwood, and green ash.

PH Longleaf pine - shortleaf pine -

upland hardwoods

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Longleaf pine and shortleaf pine, in any combination usually make up the bulk of the pine component. Loblolly pine is a common associate. Eastern redcedar occurs sporadically. Virginia pine never occurs. The most common hardwoods are mockernut hickory, blackjack oak, and post oak. Other common hardwoods are chestnut oak, scarlet oak, and southern red oak. Less common hardwood associates include pignut hickory, American beech, black oak, northern red oak, white oak, American elm, sassafras, sweetgum, black cherry, black tupelo, flowering dogwood, and sourwood. In some cases the less common species may become important stand components.

PH Mixed pines - upland hardwoods 76

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Longleaf, shortleaf, and Virginia pine, in any combination, usually make up the bulk of the pine component. Loblolly pine is a common associate. Eastern redcedar occurs sporadically. The most common hardwoods are mockernut hickory, blackjack oak, chestnut oak, and post oak. A common hardwood associate is scarlet oak. Less common hardwood associates include pignut hickory, black oak, northern red oak, southern red oak, white oak, yellow-poplar, sassafras, sweetgum, black cherry, red maple, black tupelo, flowering dogwood, and sourwood. In some cases the less common species may become important stand components.

PH Loblolly pine - upland hardwoods

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Loblolly pine usually makes up the bulk of the pine component. Shortleaf pine and Virginia pine are common associates. Longleaf pine and eastern redcedar occur sporadically. The most common hardwoods are mockernut hickory, chestnut oak, and white oak. Other common hardwoods are pignut hickory, post oak, scarlet oak, yellow-poplar, and sweetgum. Less common hardwood associates include bitternut hickory, shagbark hickory, American beech, black oak, blackjack oak, northern red oak, southern red oak, water oak, sassafras, black cherry, eastern redbud, red maple, black tupelo, flowering dogwood, sourwood, and green ash. In some cases the less common species may become important stand components.

PH Shortleaf pine - chestnut oak - white oak - hickory 76

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Shortleaf pine usually makes up the bulk of the pine component. Loblolly pine and Virginia pine are common associates. Eastern redcedar occurs sporadically. Longleaf pine never occurs. The most important hardwoods are northern red oak, post oak, scarlet oak, and southern red oak. Less common hardwood associates include pignut hickory, shagbark hickory, American beech, black oak, blackjack oak, yellow-poplar, sweetgum, black cherry, yellow buckeye, black tupelo, flowering dogwood, sourwood, and common persimmon. In some cases the less common species may become important stand components.

PH Loblolly pine - white oak 82

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Loblolly pine usually makes up the bulk of the pine component. Shortleaf pine and Virginia pine are common associates. Eastern redcedar occurs sporadically. Longleaf pine never occurs. The most important hardwood is white oak. Other common hardwoods are pignut hickory, post oak, scarlet oak, southern red oak, and yellow-poplar. Less common hardwood associates include mockernut hickory, shagbark hickory, American beech, black oak, chestnut oak, northern red oak, water oak, winged elm, sassafras, American sycamore, black cherry, red maple, yellow buckeye, black tupelo, flowering dogwood, sourwood, and green ash. In some cases the less common species may become important stand components.

PH Loblolly pine - shortleaf pine -

post oak - southern red oak

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Loblolly pine and shortleaf pine, in any combination, make up the bulk of the pine component. Longleaf pine is a common associate. Virginia pine and eastern redcedar occur sporadically. The most important hardwoods are post oak and southern red oak. Other common hardwoods are blackjack oak, scarlet oak, and white oak. Less common hardwoods are blackjack oak, scarlet oak, and white oak. Less common hardwood associates include mockernut hickory, pignut hickory, shagbark hickory, black oak, chestnut oak, chinkapin oak, northern red oak, water oak, American elm, yellow-poplar, sassafras, sweetgum, black cherry, eastern redbud, red maple, black tupelo, flowering dogwood, sourwood, and green ash. In some cases the less common species may become important stand components.

PH Loblolly pine - oak - sweetgum 82

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Loblolly pine usually makes up the bulk of the pine component but shortleaf pine often is the dominant pine. Virginia pine and eastern redcedar occur sporadically. Longleaf pine never occurs. The most important hardwoods are scarlet oak, southern red oak, water oak, white oak, and sweetgum. Post oak is a common associate. Less common hardwood associates include black willow, mockernut hickory, pignut hickory, shagbark hickory, hazel alder, American beech, northern red oak, American elm, winged elm, yellow-poplar, sassafras, black cherry, eastern redbud, red maple, yellow buckeye, American basswood, black tupelo, flowering dogwood, sourwood, and green ash. In some cases the less common hardwood species may become important stand components.

PH

Loblolly pine - branch

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Loblolly pine makes up the bulk of the pine component. The other pines and eastern redcedar occur sporadically. The most important hardwoods are white oak, yellow-poplar, and sweetgum. Other common hardwoods are water oak, red maple, and green ash. Less common hardwoods include black willow, bitternut hickory, mockernut hickory, pignut hickory, shagbark hickory, hazel alder, American hornbeam, American beech, black oak, blackjack oak, chestnut oak, post oak, scarlet oak, southern red oak, American elm, winged elm, sugarberry, sweetbay, American sycamore, black cherry, boxelder, American basswood, black tupelo, and flowering dogwood. In some cases the less common species may become important stand components.

PH

Loblolly pine - swamp hardwoods

Type Description

30 to 70 percent of the basal area of the overstory is made up of pine. Loblolly pine is the only pine found in the swamps. Eastern redcedar occurs sporadically. The most important hardwoods are water oak, white oak, sweetgum, and red maple. Other common hardwoods are bitternut hickory, southern red oak, willow oak, black tupelo, and green ash. Less common hardwood associates include black willow, pignut hickory, hazel alder American hornbeam, swamp chestnut oak, American elm, sugarberry, sweetbay, yellow-poplar, American sycamore, and boxelder. In some cases the less common species may become important stand components.

H

Blackjack oak - mockernut hickory

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. Longleaf pine and shortleaf pine make up the bulk of the pine component. Loblolly pine and eastern redcedar occur sporadically. Virginia pine does not occur. The most common hardwoods are mockernut hickory and blackjack oak. Other common hardwoods are chestnut oak, post oak, scarlet oak, and southern red oak. Less common hardwood associates include pignut hickory, black oak, northern red oak, white oak, sassafras, sweetgum, black cherry, black tupelo, flowering dogwood, and sourwood. In some cases the less common species may become important stand components.

H

Mockernut hickory - white ash - blackjack oak

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. Longleaf pine is the most common pine. Loblolly pine, shortleaf pine, and eastern redcedar occur sporadically. Virginia pine does not occur. The most important hardwoods are mockernut hickory and post oak. Other common hardwoods are blackjack oak, chestnut oak, scarlet oak, southern red oak, white oak, yellow-poplar, and sweetgum. Less common hardwood associates include pignut hickory, black oak, northern red oak, sassafras, black cherry, red maple, black tupleo, flowering dogwood, and sourwood. In some cases the less common species may become important stand components.

H

Chestnut oak - mockernut hickory

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. The pine component may be made up of any of the pines, in any combination, but shortleaf pine often is the most important pine. Eastern redcedar occurs sporadically. The most important hardwoods are mockernut hickory, blackjack oak, chestnut oak, and post oak. Other common hardwoods are pignut hickory, scarlet oak, and white oak. Less common hardwood associates include shagbark hickory, black oak, northern red oak, southern red oak, winged elm, sugarberry, yellow-poplar, sassafras, sweetgum, black cherry, eastern redbud, black locust, red maple, black tupelo, flowering dogwood, sourwood, and green ash. In some cases the less common species may become important stand components.

H

Oak - hickory

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. The pine component may be made up of any of the pines, except longleaf pine, in any combination. Eastern redcedar occurs sporadically. The most important hardwoods are pignut hickory, chestnut oak, northern red oak, and white oak. Other common hardwoods are mockernut hickory, shagbark hickory, scarlet oak, yellow-poplar, and green ash. Less common hardwood associates include American beech, black oak, post oak, southern red oak, American elm, winged elm, common blackberry, sassafras, sweetgum, American sycamore, black cherry, eastern redbud, black locust, red maple, American basswood, black tupelo, flowering dogwood, sourwood, and common persimmon. In some cases, the less common species may become important stand components.

H

Hickory - oak

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. Loblolly pine and shortleaf pine, in any combination, usually make up the bulk of the pine component. Virginia pine and eastern redcedar occur sporadically. Longleaf pine does not occur. The most important hardwoods are mockernut hickory, chestnut oak, northern red oak, post oak, and white oak. Other common hardwoods are pignut hickory, shagbark hickory, black oak, and scarlet oak. Less common hardwood associates include American beech, blackjack oak, southern red oak, winged elm, yellow-poplar, sassafras, sweetgum, black cherry, eastern redbud, red maple, black tupelo, flowering dogwood, sourwood, and green ash. In some cases, the less common species may become important stand components.

H

Beech - oak

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. The pine component is made up of loblolly pine, shortleaf pine, and/or Virginia pine, in any combination. Eastern redcedar occurs sporadically. The most important hardwoods are American beech, northern red oak, and white oak. Other common hardwoods are mockernut hickory, shagbark hickory, chestnut oak, scarlet oak, yellow-poplar, sweetgum, and green ash. Less common hardwood associates include pignut hickory, black oak, post oak, southern red oak, winged elm, sugarberry, sassafras, black cherry, red maple, black tupelo, flowering dogwood, and sourwood. In some cases, the less common species may become important stand components.

H

Oak

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. Loblolly pine usually makes up the bulk of the pine component but any of the other pines may be present. Eastern redcedar occurs sporadically. The most important hardwoods are post oak, scarlet oak, southern red oak, and white oak. Other common hardwoods are mockernut hickory, shagbark hickory, yellow-poplar, and sweetgum. Less common hardwood associates include pignut hickory, American beech, blackjack oak, chestnut oak, Chinkapin oak, northern red oak, water oak, American elm, sassafras, black cherry, eastern redbud, red maple, American basswood, black tupelo, flowering dogwood, sourwood, and green ash. In some cases, the less common species may become important stand components.

H

Oak - sweetgum

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. Loblolly pine usually makes up the bulk of the pine component Shortleaf pine and eastern redcedar occur sporadically. The most important hardwoods are water oak, white oak, and sweetgum. Other common hardwoods are pignut hickory, shagbark hickory, American beech, northern red oak, post oak, scarlet oak, southern red oak, and green ash. Less common hardwood associates include black willow, bitternut hickory, mockernut hickory, hazel alder, black oak, swamp chestnut oak, American elm, sugarberry, yellow-poplar, black cherry, eastern redbud, honeylocust, red maple, American basswood, black tupelo, flowering dogwood, sourwood, and common persimmon. In some cases, the less common species may become important stand components.

H

Branch hardwoods 59

Type Descriptions

Less than 30 percent of the basal area of the overstory is made up of pine. Loblolly pine makes up the bulk of the pine component but any of the pines may be present. Eastern redcedar occurs sporadically. The most important hardwoods are water oak, white oak, yellow-poplar, and sweetgum. Other common hardwoods are, American beech, red maple, and green ash. Less common hardwood associates include black willow, eastern cottonwood, bitternut hickory, mockernut hickory, pignut hickory, shagbark hickory, river birch, hazel alder, American hornbeam, black oak, chestnut oak, northern red oak, post oak, scarlet oak, southern red oak, swamp chestnut oak, willow oak, American elm, winged elm, common hackberry, sugarberry, sweetbay, sassafras, American sycamore, black cherry, eastern redbud, honeylocust, black locust, boxelder, yellow buckeye, American basswood, black tupelo, flowering dogwood, sourwood, and common persimmon. In some cases, the less common species may become important stand components.

H

Coosa River hardwoods

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. Loblolly pine makes up the bulk of the pine component. Longleaf pine, shortleaf pine, and eastern redcedar occur sporadically. The most important hardwoods are water oak, white oak, and green ash. Other common hardwoods are shagbark hickory, northern red oak, sugarberry, yellow-poplar, sweetgum, American sycamore, and red maple. Less common hardwood associates include black willow, eastern cottonwood, bitternut hickory, mockernut hickory, pignut hickory, river brich, hazel alder, American hornbeam, American beech, scarlet oak, southern red oak, swamp chestnut oak, American elm, black cherry, boxelder, silver maple, American basswood, black tupelo, flowering dogwood, and sourwood. In some cases, the less common species may become important stand components.

H

Swamp hardwoods

Type Description

Less than 30 percent of the basal area of the overstory is made up of pine. Loblolly pine is the only pine found in the swamps. Eastern redcedar occurs sporadically. The most important hardwoods are water oak, white oak, sweetgum, and red maple. Other common hardwoods are bitternut hickory, southern red oak, willow oak, black tupelo, and green ash. Less common hardwood associates include black willow, pignut hickory, hazel alder, American hornbeam, American beech, swamp chestnut oak, American elm, winged elm, sugarberry, sweetbay, yellow-poplar American sycamore, boxelder, American basswood, flowering dogwood, and common persimmon. Water tupelo occurs as small patches in the wettest portions of the swamps adjacent to the streams and in areas of standing water. In some cases, the less common species may become important stand components.

H

Hazel alder

Type Description

Hazel alder forms the bulk of the vegetative cover with scattered black willows, yellow-poplar, sweetgum and other wet site species forming an overstory.

H

Black willow

95

Type Description

Black willow forms the bulk of the overstory. Eastern cottonwood and river birch are common associates. Hazel alder also is often present.

PHYSICAL CHARACTERISTICS OF THE CAHABA RIVER

1. Introduction

To understand and appreciate the complexities of the Cahaba River, its aquatic organisms, and the many ecosystems within this dynamic system a description of the river and its physical characteristics is required. Following this discussion the flora and fauna of the river will be discussed.

2. Cahaba River Basin

The Cahaba River flows entirely within Alabama in a generally southwestern direction. It drains an area of 4843 sq. km (1870 square miles) covering portions of Bibb, Chilton, Dallas, Jefferson, Perry, St. Clair, Shelby, and Tuscaloosa Counties. Principal tributaries are Buck, Cahaba Valley, Mahan, Oakmulgee, Shades and Six Mile Creeks and the Little Cahaba River. Topographic and geologic features of the upper reaches of the basin tend to cause rapid runoff with the resultant wide fluctuation of stream flow, while the lower portions, because of the flatter topography and changes in geologic formations exhibit smaller flow variations.

Physical Characteristics of the Cahaba River (Frey, et al 1976; Foshee, 1975)

The Cahaba River has its headwaters in the Cahaba Mountains of Alabama and is a typical spring-fed stream until it nears Trussville, Alabama. The upper reach of the river can be divided into sections based on changes in physical characteristics of the river. A 96 km (59.6 miles) portion of the Cahaba River was surveyed in this study (Figure 1). Not all sections were similar in length, since accessibility was also a factor in designation of section lengths. Following are descriptions of the twelve study sections:

Section 1 - Immediately downstream from Echo Lake to 0.4 km (0.25 miles) upstream from Lake-in-the-Woods.

Section 2 - Four-tenths km (0.25 miles) upstream from Lake-in-the-Woods to Interstate Highway 59 bridge.

Section 3 - Interstate Highway 59 bridge to Highway 11 bridge at Trussville.

Section 4 - Highway 11 bridge downstream to old highway bridge near Lovick, Alabama.

Section 5 - Lovick, Alabama to Grants Mill Road.

Section 6 - Grants Mill Road to Horseshoe Bend near Overton, Alabama, at river mile (RM) 35.

Figure 1. Diagrammatic map showing reference points on the portion of the Cahaba River covered in The Frey (1976) Survey, and referred to in the description of the physical characteristics discussion.

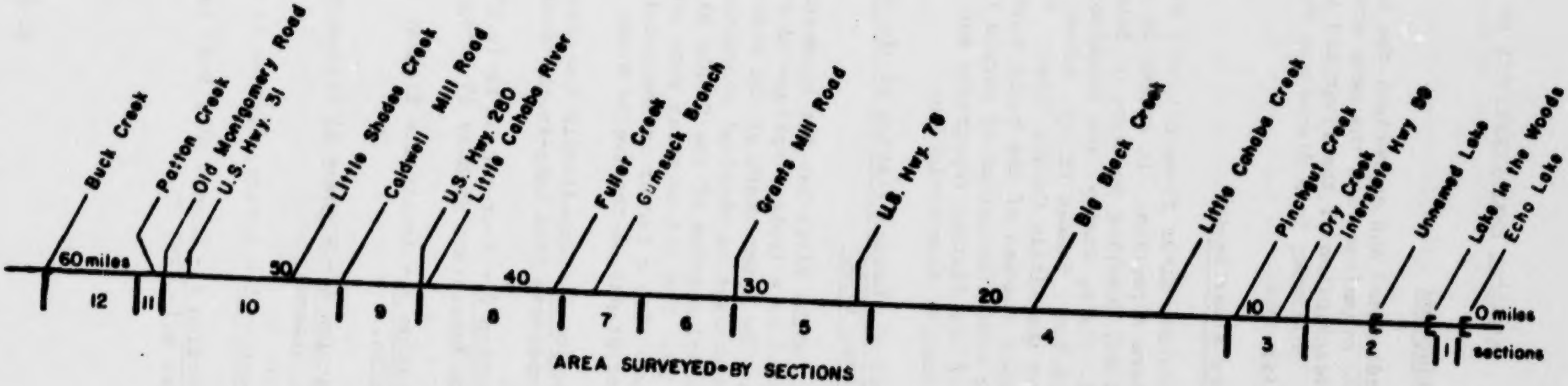
Buck Creek
Patton Creek
Old Montgomery Road
U.S. Hwy. 31
Little Shades Creek
Caldwell Mill Road
U.S. Hwy. 280
Little Cahaba River
Fuller Creek
Gumsuck Branch
Grants Mill Road
U.S. Hwy. 78
Big Black Creek
Little Cahaba Creek
Pinchgut Creek
Dry Creek
Interstate Hwy 59
Unnamed Lake
Lake in the Woods
Echo Lake
60 miles
50
40
30
20
10
0 miles
12
11
10
9
8
7
6
5
4
3
2
1
sections
AREA SURVEYED-BY SECTIONS

Figure 1

Section 7 - Horseshoe Bend to River Run Estates bridge.

Section 8 - River Run Estates bridge to Highway 280 bridge.

Section 9 - Highway 280 bridge downstream to Caldwell Mill Road.

Section 10 - Caldwell Mill Road to Old Montgomery Road.

Section 11 - Old Montgomery Road to the confluence of Patton Creek.

Section 12 - Confluence of Patton Creek to the confluence of Buck Creek.

Section 1, which includes the headwaters below Echo Lake to approxmately 0.4 km (0.25 mi) upstream from Lake-in-the-Woods, is a small stream 2 to 3 meters (6.6-6.9 feet) wide with a depth of 15 to 20 centimeters (5.9-7.9 inches). Seepage from small pools contributed to minimal flows throughout the reach. The stream bed is generally bedrock with boulders and pebbles entrapping leaf litter. Small riffles occur at the end of this stream section as flow increases. The gradient in this section is about 8.5 meters (m) per km (44 ft/mile). Trees overhand the stream banks along the entire reach.

Section 2, extending from just above Lake-in-the-Woods to approximately 0.8 km (0.5m) below I-59 Bridge, is a more free-flowing stream with a 5 to 7 meter (16.4-22.9 feet) width and depths from 15 centimeters (5.9 inches) to 1 m (3.3 feet). There are stretches of beautiful riffles 7 to 10 meters (22.9-32.8 feet) long interrupted by an occasional pool. The stream bed is still bedrock with riffles having large boulders and slabs covered with river weed. The emergent plants - water willow and watercress - are found in patches along the stream margin. The river still drops at a rate of about 8.5 m per km (44 ft/mile).

The river becomes wider, 10 m (32.8 feet), in Section 3, with some pools having depths of 1.2 meters (3.91 feet). Riffle areas are fewer but are much similar to riffle areas of Section 2. However, more silt and sand are evident in the stream bed than in the previous sections. The gradient has become reduced and is now about 1.6 m per km (8.45 ft/mile).

Section 4 is a much wider (17 to 35 meters) (55.8-114.8 feet) stretch of the river. There are long pools throughout this reach having depths of 0.2 to 1.1 meters (0.7-3.6 feet). These pools are interrupted by long riffles of boulders, rocks, slabs, and islands. Three rapids are present in this section. Steeper terrain is evidenced by bluffs along much of this river section. Virginia hardwood timber densely line the stream banks. The average gradient of the river in this section is 1.6 m per km (8.45 ft/mile).

The Cahaba River from Lovick, Alabama, to approximately 6.4 km (3.9 miles) upstream from the dam near Highway 280 (Sections 4 through 8) maintains the characteristics exhibited in Section 4. The river is about 15.2 m (50 feet) wide, and consists of long, relatively shallow pools with solid bedrock bottoms. These pools are broken by long riffles which consist of large, flat rocks or short cataracts. The bank of the river is lined with mixed forest which at times contains what appears to be stands of magnificent virgin timber. Some rocky banks are evident. Generally the flood plain is restricted by steep terrain which includes high picturesque bluffs. At times, the river is strewn with large boulders. The Little Cahaba River which enters the Cahaba River above U.S. Highway 280, averages about 25-30 feet in width. Rocky shoals, small islands, drops, low falls and slow moving pools are present. The banks are usually wooded and hilly with numerous boulder formations, low bluffs, and rocky hillsides along and just back from the river's edge. Several small streams and creeks enter the river at various points.

Just downstream from Highway 280 (Section 9), the river is impounded by a low-level dam. At the dam the river is about 45.7 m (150 feet) wide. This dam affects approximately 0.4 km (0.25 miles) of the river. In the upper reaches of this stretch of the river, the current moves slowly downstream to the Cahaba River water treatment pump station intake. The river banks are lined with hardwood trees, many of which have fallen into the river. The bottom is bedrock covered with silt and water depth is uniform, averaging about 2.1 meters (6.9 feet). From the pump station intake downstream to the low level dam, the physical appearance of the river is the same, except the water is flowing slowly upstream toward the pumping station. However, this body of water moving upstream is visually different from that moving downstream, since it is water being released from Lake Purdy which travels down the Little Cahaba River and then up the Cahaba to the pumping station. The portion of the river below the intake is about 50 meters (164 feet) wide with a maximum depth of 4 meters (13.1 feet) and an average depth of about 3 meters (9.8 feet). The banks of the river are lined with large trees, many of which have fallen into the river. The bottom of the river in the downstream portion near the dam is covered with considerable amounts of silt and organic material. However, during such time when the flow in the Cahaba River increases sufficiently to adequately supply the pump station, the portion of the river between the pumping station and the confluence of the Little Cahaba River would probably be very similar to the reach of the impoundment upstream from the pumping station.

The run-of-the-river dam at the Highway 280 bridge is the first of a series of low-level dams impounding the river. Damming of the Cahaba River continues downstream to Caldwell Mill Road, where five small (approximately 1 meter (3.28 feet) high) private run-of-the-river dams have been constructed in that stretch of the river (Section 9). Section 9 is virtually pooled its entire length except where riffle areas exist just downstream of the dams. Maximum water depth was about 1.6 meters (5.25 feet) or greater in this stretch of the river, and the bottom was rubble and sediment.

From Caldwell Mill Road (County 29) to Montgomery Road (Section 10), the river was shallow and free-flowing, consisting of riffles and pools with a bottom of rock outcrops, rubble, and sand intermingled with coal fines. The river was strewn with fallen trees, which made passage downstream difficult at times. The river is 12.2 m (40 feet) wide at County 29 and widens to 15.2 m (50 feet) at Mongtomery Road. Much of this stretch is bordered by 1.3 to 2.9 meter (6-8 feet) high banks. These are covered by wide flat areas. Two golf courses are located along this stretch. A number of islands and flats exist in this stretch of the river.

Many creeks in Sections 9 and 10, especially those draining mining areas, formed sedimentation deltas into the Cahaba River.

The Cahaba River from Old Montgomery Road bridge to its confluence with Buck Creek ranges from 15.2 m (50 feet) wide to about 22.9 m (75 feet) wide just below Buck Creek. In the portions of the river that were observed, the river consisted of relatively deep pools divided by shoals. The bottom of the pools are bedrock and the shoals were comprised of large, flat rocks interspersed with gravel and sand. Generally speaking, the terrain along the river is quite steep, although there are some low-lying agricultural areas interspersed with the rough terrain. The banks of the river are lined with mature timber, some of which is falling into the river. The high trash line in the standing trees indicates extreme flooding conditions exist in this portion of the river.

The gradient of the river can be divided into three segments. Segment 1 begins at Echo Lake at an elevation of 316.9 m (1040 feet) above mean sea level (msl) and extends to about Interstate Highway 59 where the elevation is about 201.1 m (660 feet) above msl. Within this segment, the river drops about 8.5 m per km (47 ft/mile). The second segment begins at Interstate Highway 59 and extends to Lovick, Alabama. The gradient is much reduced within this segment, with an average drop of about 1.5 m per km (9 ft/mile). The remaining 57 km (36 miles) of the study area are in Segment 3. In this segment, the average drop of the river is about 0.8 m per km (4 ft/mile). The total drop in elevation in the river through the study area is 201 m (670 feet).

Uses of the Cahaba River

The Cahaba River provides recreational uses consisting of boating, canoeing, swimming, picknicking, biking, hunting, fishing, sightseeing and camping.

Past and Present Impacts Upon the Cahaba River

Numerous activities within the basin represent potential dangers that threaten the floral and faunal activity of the Cahaba River. Adverse impacts upon this river may result from strip mining of coal, stream channelization, clear cutting without erosion control, sand and gravel mining and washing operations, or population increases within the basin. In addition, river enrichment occurs from agricultural and recreational lands adjoining the river.

Specific problems include turbidity increases and sedimentation due to strip mining, basin development and lagoon breaks, organic debris from the heavy vegetative growths occurring along the river banks and human debris (beer cans, paper cups and metal debris) found in access areas along the river.

The U.S. Environmental Protection Agency (EPA)(Frey, et al 1976) reported pollution sources impacting the river by section (see Figure 1.2) within Jefferson and Shelby counties. Table 1.1 presents this data.

Periodically in the past, but apparently not within the last two years (1974-1976) a series of fish kills has occurred in the river. In one case, mortalities exceeded 15,000 fishes. Table 1.2 summarizes these incidents.

Table 1-1 Pollution sources along the Upper Cahaba River
(Frey, et al 1976)

Location	Type of Pollution
Section 3 - Near Trussville	Siltation and turbidity from construction along river
Section 4 - Trussville STP outfall 182.8 m (200 yards) downstream from Highway 11	Combined sewage from Trussville
Section 4 - Pinchgut Creek 91.4 m (100 yards) downstream from Trussville STP outfall	Domestic sewage from mobile home complex
Section 4 - Little Cahaba Creek	Discharge from Purina Checkerboard Poultry Processing Plant into small tributary of Little Cahaba Creek
Section 4 - Black Creek RM 19	Black Creek drains strip-mined area -- no problem during course of study, but possible problems during periods of high runoff
Section 5 - Small creek draining Jefferson Park area	Creek highly enriched -- probably no point source
Section 7 - Two small creeks near RM 36	Low pH draining old strip-mine area
Section 8 - Medium creek near Overton RM 38	Creek apparently carries a heavy silt load during periods of high runoff
Section 8 - Small creek near RM 40	Intermittent high sediment load, yellow clay
Section 8 - Fleming Branch	Many coal fines
Section 8 - Little Cahaba Branch	Discharge of Leads STP, Lake Purdy
Section 9 - 2.4 km (1.5 miles) upstream from Caldwell Mill Road	Golf course on river bank
Section 9 - Fifth dam at Caldwell Mill Road	Shelby County emergency sewage discharge
Section 10 - Downstream from Caldwell Mill Road	Altadena apartments sewage line

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Table 1-1 (Continued)

Location	Type of Pollution
Section 10 - Near Highway 31	Highway culvert just upstream from Acton Creek
Section 10 - 0.8 km (0.5 mile) upstream from Highway 31	Cahaba River sewage treatment plant (STP)
Section 10 - Just downstream from Highway 31 bridge	Golf course along river
Section 10 - Near Old Montgomery Road bridge	Industrial waste ditch (marble processing)
Section 11 - Patton Creek	Patton Creek STP discharges into Patton Creek

Table 1-2 - Summary of Cahaba River Fish Kills

Date	Description
1965	Trussville, Alabama; 1750 suckers dead
1965	5475 fishes dead
1968	15,081 fishes dead
August 1970	Centreville, Alabama Discharge of pentachlorophenol (wood preservative) by W.E. Belcher Lumber Co. 7415 fish dead including largemouth bass, spotted bass, walleye, bream, buffalo, drum, channel, flathead and bullhead catfish, river red horse, spotted suckers and carp.
September 1970 1968	Mann. Bros. Metalplating Co. had routine spills of cyanide into creek.
May 1965	Also 400 lb. container of calcium sulfate dumped into river, resulting pH = 10.0; 12,500 fishes dead including bass, beam and suckers.
1973	Ralston Purina Plant discharges in excess of 1 MGD. BOD removal 85%.
1973	Caustic soda spill resulted in six dead fish.

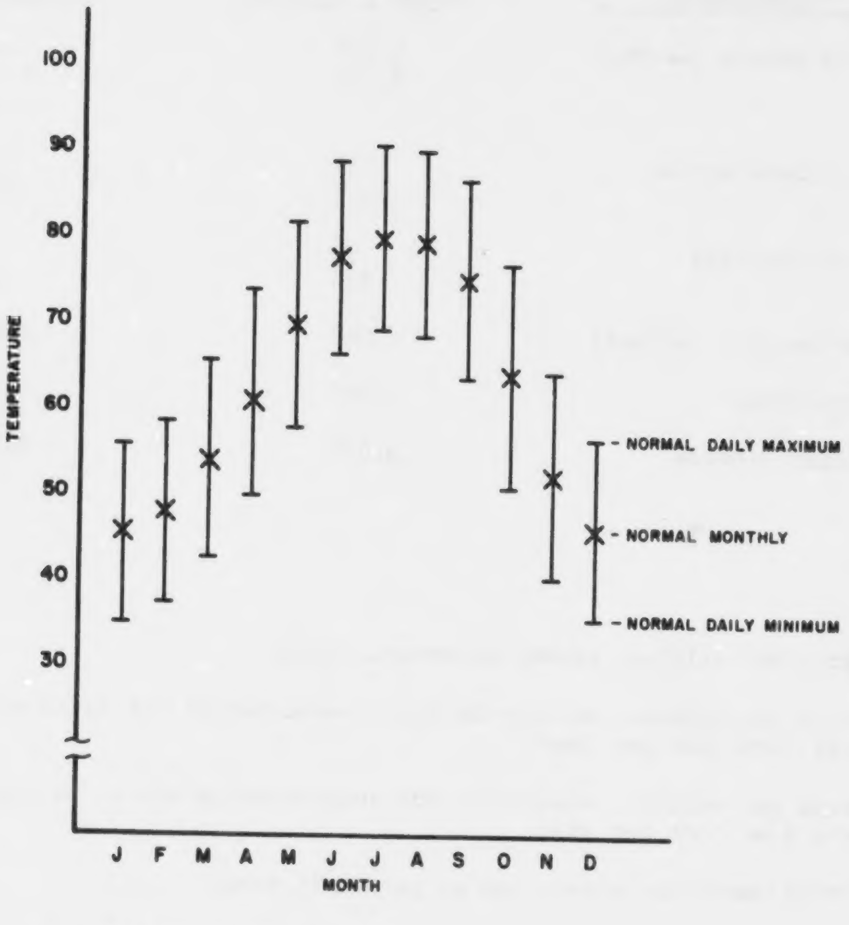
TABLES

NATURAL ENVIRONMENT

AI-26.a

TABLE AI-1

MONTHLY TEMPERATURE RANGES
CAHABA RIVER BASIN *



* TEMPERATURE RANGES RECORDED AT BIRMINGHAM MUNICIPAL AIRPORT
PERIOD OF RECORD 1921-1950

SOURCE: U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU "CLIMATES OF THE STATES: ALABAMA"
FEBRUARY, 1959.

TABLE AI-2
AMBIENT AIR QUALITY STANDARDS OF ALABAMA

Contaminant	Primary Standard	Secondary Standar
Sulfur oxides (as SO_2)	0.03[a] 0.14[b]	0.02[a] 0.10[b] 0.50[c]
Particulate matter	75[d] 260[e]	60[d] 150[e]
Carbon monoxide	9[f] 35[g]	9[f] 35[g]
Photochemical oxidants	0.08[g]	0.08[g]
Hydrocarbons	0.24[c]	0.24[c]
Nitrogen dioxide	0.05[a]	0.05[a]

[a] Parts per million, annual arithmetic mean.

[b] Parts per million, maximum 24-hour concentration not to be exceeded more than once per year.

[c] Parts per million, maximum 3-hour concentration not to be exceeded more than once per year.

[d] Micrograms/cubic meter, annual geometric mean.

[e] Micrograms/cubic meter, maximum 24-hour concentration not to be exceeded more than once per year.

[f] Parts per million, maximum 8-hour concentration not to be exceeded more than once per year.

[g] Parts per million, maximum 1-hour concentration not to be exceeded more than once per year.

TABLE AI-3

1975 AIR POLLUTANT CONCENTRATIONS IN THE BIRMINGHAM AREA

Contaminant	Downtown Birmingham	North Birmingham	Fairfield	Leeds	Mountain Brook
Suspended Particulates (gm/m^3)	82.1 (a)*	136.8 (a)*	74.0 (a)	136.8 (a)*	44.6 (a)
	260 (b)	446 (b)	229 (b)	599 (b)	143 (b)
	234 (c)	431 (c)*	206 (c)	559 (c)*	109 (c)
Sulfur Dioxide (ppm)	0.002 (a)	0.002	0.005	0.001	-
	0.010 (b)	0.015	0.023	0.002	-
	0.008 (c)	0.013	0.020	0.002	-
Nitrogen Dioxide (ppm)	0.029 (d)	0.027	0.020	0.013	-
Carbon Monoxide (ppm)	15 (e)	22	27	-	-
	9 (f)	15	17	-	-
	10 (g)	10	13	-	-
	<9 (h)	<9	11*	-	-
Ozone (ppm)	0.119 (c)	0.098	0.140	-	-
	0.113 (f)	0.076	0.086	-	-
Total Hydrocarbons (ppm)	10(e) 9(f)	20(e) 12(f)	-	-	-

a. Annual Geometric Mean
b. Maximum 24-Hour
c. Second Highest 24-Hour
d. Annual Arithmetic Mean
e. Maximum 1-Hour
f. Second Highest 1-Hour
g. Maximum 8-Hour
h. Second Highest 8-Hour

* Indicates Non-compliance With Primary Standard

Sources: John W. Powell, Statistician, Bureau of Environmental Health, Jefferson County Department of Health, letter to GFC&C, October 8, 1976.

Ken Barrett, Chief, Technical Services Section, Alabama Air Pollution Control Commission, letter to GFC&C, October 29, 1976.

TABLE AI-4

CAHABA RIVER BASIN
GEOLOGIC FORMATIONS

System	Geologic Map Symbol	Stratigraphic Unit	Rock Character
Pennsylvanian	IPpv	Pottsville Formation	Sandstone, tan to gray, thin- to thick- bedded; tan to dark-gray shale; and many coal beds.
Mississippian	Mpp	Parkwood Formation	Sandstone, light-gray to white, fine-grained, thin- to medium-bedded, and well cemented.
	Mpp	Pennington Formation	Shale, red and tan.
	Mf	Floyd Shale	Shale, gray to black, light-brown, and dull green; fine-grained thin-bedded sandstone; siltstone and thin ferruginous beds.
	Mb	Bangor Limestone	Limestone, gray to dark blue-gray, medium- to thick-bedded crystalline, fossiliferous, and and nodules of dark-gray chert.
	Mh	Hartselle Sandstone	Siltstone, weathers brown in the lower part; and light-gray fine-grained thin- to medium-bedded laminated sandstone in the upper part.
	Mfp	Fort Payne Chert	Limestone, light-gray or or white, thin- to medium-bedded, siliceous, and nodules of light-gray to dark-gray chert.
Devonian	Dfm	Frog Mountain Sandstone	Sandstone, tan, gray, or gray with red stain, thin- to medium-bedded, and sandy shale.

TABLE AI-4(Cont'd)

CAHABA RIVER BASIN
GEOLOGIC FORMATIONS

System	Geologic Map Symbol	Stratigraphic Unit	Rock Character
Silurian	Srm	Red Mountain Formation	Shale, brown, red, and green, includes ferruginous beds in the lower half and brown fine-grained thin- to thick-bedded sandstone in the upper half of the formation. The formation becomes thinner southeastward in the county.
Ordovician	Oc	Chickamauga Limestone	Shale, red and (or) green; red coarse-grained sandstone; and gray thin- to thick-bedded limestone. In the northern part of the county, the basal part contains a layer of conglomerate containing chert gravel.
	Olm	Little Oak Limestone	Limestone, dark-gray, thick-bedded, coarsely crystalline.
	Olm	Lenoir Limestone	Limestone, dark-gray, medium thick-bedded, finely crystalline.
	Olm	Mosehiem Limestone	Limestone, blue-gray, thick-bedded, compact, and brittle.
	Ool	Odenville Limestone	Limestone, dark-gray, fine-grained, siliceous, cherty, impure, and argillaceous.
	Ool	Newala Limestone	Limestone, dark- to pearl-gray, thick-bedded and very little dolomite.
	Ool	Longview Limestone	Limestone and dolomite, light-gray, thick-bedded, cherty.

TABLE AI-4 (Cont'd)

CAHABA RIVER BASIN GEOLOGIC FORMATIONS

System	Geologic Map Symbol	Stratigraphic Unit	Rock Character
Ordovician and Cambrian	OCu	Chepultepec, Copper Ridge, and Ketona Dolomites	Dolomite, light- to dark-gray, medium- to thick-bedded; weathers to a cherty clayey subsoil.
Cambrian	Cr	Rome Formation	Shale, red and green interbedded with green to tan thin-bedded sandstone.

TABLE AI-5

GENERAL ENGINEERING CHARACTERISTICS OF ROCKS IN THE GREATER BIRMINGHAM AREA

Age	Formation	Map Symbol[1]	Lithology	General Ease of Evacuation[2]	Potential Foundation Stability Problems	Potential Cut Slope Stability Problems
Cambrian	Rome	€r	Shale	Rip	None	None
Ordovician and Cambrian	Chepultepec	O€u	Dolomite	Rip	Sinkholes	None
	Copper Ridge	O€u	Dolomite	Rip	Sinkholes	None
	Ketona	O€u	Dolomite	Blast	Sinkholes	None
Ordovician	Longview	Ool	Limestone	Blast	Sinkholes	None
	Newala	Ool	Limestone	Blast	Sinkholes	None
	Odenville	Ool	Limestone	Blast	Sinkholes	None
	Mosheim Oc	Olm	Limestone	Blast	Sinkholes	None
	Lenoir	Olm	Limestone	Blast	Sinkholes	None
	Little Oak	Olm	Limestone	Blast	Sinkholes	None
	Chickamauga	Oc	Limestone-Shale	Blast	Sinkholes	None
Silurian	Red Mountain	Srm	Shale	Blast	Mine Subsidence	None
Mississippian	Fort Payne	Mfp	Chert-Limestone	Blast	Sinkholes	None
	Hartselle	Mh	Sandstone	Blast	None	None
	Bangor	Mb	Limestone	Blast	Sinkholes	None

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[1] Refers to area mapped on Figure 3-5, "Geology".

[2] Ease of Excavation is variable and dependent on the local site conditions

TABLE AI-5 (Cont'd)

GENERAL ENGINEERING CHARACTERISTICS OF ROCKS IN THE GREATER BIRMINGHAM AREA

Age	Formation	Map Symbol[1]	Lithology	General Ease of Evacuation[2]	Potential Foundation Stability Problems	Potential Cut Slope Stability Problems
Mississippian	Floyd	M_f	Shale	Blast	None	Landslide
	Parkwood	Mpp	Sandstone-Shale	Blast	None	Landslide
Pennsylvanian	Pottsville	Ppv	Sandstone-Shale	Blast	None	Landslide
Quaternary	Alluvium	Qal	Sand-Gravel-Clay	Rip	None	None

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[1] Refers to area mapped on Figure 3-5, "Geology".

[2] Ease of Excavation is variable and dependent on the local site conditions

TABLE AI-6

AQUIFER CHARACTERISTICS

System	Geologic Map Symbol	Stratigraphic Unit	Water-Bearing Properties	Ground-Water Recharge Potential	General Ground-Water Quality
Pennsylvania	Ppv	Pottsville Formation	In places, wells yield as much as 165 gpm but generally less than 50 gpm.	Low	Water is generally high in iron and some samples have high hardness.
Mississippian	Mpp	Parkwood Formation	Generally a poor aquifer with variable water quality.	Low	Some samples have high iron and hardness.
	Mpp	Pennington Formation		Low	Same as above.
	Mf	Floyd Shale	Yields water to domestic wells. Supplies from dug wells usually are adequate during the dry season.	Low	Same as above.
	Mb	Bangor Limestone	Yields large amounts of water to wells which intersect joints and solution channels, and as much as 1,500 gpm to springs.	High	Water is generally hard.
	Mh	Hartselle Sandstone	Yields as much as 250 gpm in wells, and as much as 1,500 gpm to springs.	Medium	Water has variable hardness levels and may have high iron concentrations.
	Mfp	Fort Payne Chert	Yields adequate water to wells for domestic use. Source for springs that yield as much as 400 gpm.	Medium	Water has high hardness.

TABLE AI-6 (Cont'd)

AQUIFER CHARACTERISTICS

System	Geologic Map Symbol	Stratigraphic Unit	Water-Bearing Properties	Ground-Water Recharge Potential	General Ground-Water Quality
Devonian	Dfm	Frog Mountain Sandstone	No information available.	Low	
Silurian	Srm	Red Mountain Formation	Yields adequate water to wells for domestic use that is often of poor quality.	Low	Water quality is poor with high iron sulfate, hardness, and dissolved solids.
Ordovician	Oc	Chickamauga Limestone	Yields adequate water to domestic wells. Generally a good aquifer in the limestone section.	High	Water has high hardness.
	Olm	Little Oak Limestone	Wells and springs yield from 2 to 400 gpm that is used for domestic, stock, industrial, and public supplies.	High	Water has high hardness.
	Olm	Lenoir Limestone	Same as above.	High	Water has high hardness.
	Olm	Mosehiem Limestone	Same as above.	High	Water has high hardness.
	Ool	Odenville Limestone	Yields adequate water to wells for domestic use and will probably yield large quantities to wells that penetrate fractures and solution openings.	High	Water has high hardness.

TABLE AI-6 (Cont'd)

AQUIFER CHARACTERISTICS

System	Geologic Map Symbol	Stratigraphic Unit	Water-Bearing Properties	Ground-Water Recharge Potential	General Ground-Water Qualit
Ordovician (Cont'd)	Ool	Newala Limestone	Yields adequate water to wells for domestic use and will probably yield large quantities to wells that penetrate fractures and solution openings.	High	Water has high hardness.
	Ool	Longview Limestone	Same as above.	High	Water has high hardness.
Ordovician and Cambrian	OЄu	Chepultepec, Copper Ridge, and Ketona Dolomites	Source of water for many wells and springs. Wells 150 gpm and springs as much as 2,500 gpm.	High	Water has high hardness.
Cambrian	Єr	Rome Formation	Poor aquifer.	Low	Water quality is generally poor.

Table AI-7 - Amphibians and Reptiles Reported In The Upper Cahaba River Drainage Basin (Mount, 1975)

Amphibians - Frogs

Bufo americanus - American toad

Bufo terrestris - Southern toad

Bufo woodhousei - Fowlers toad

Acris crepitans - The northern cricket frog

Hyla cinerea - The green treefrog

Hyla crucifer - The northern spring peeper

Hyla gratiosa - The barking treefrog

Hyla versicolcr - Gray treefrog

Pseudacris brachyphona - Mountain chorus frog

Pseudacris triserata feriarum - The upland chorus frog

Gastrophryne carolinensis - Eastern narrow-mouthed toad

Scaphiopus holbrooki holbrooki - Eastern spadefoot

Rana areolata sevosa - Dusky gopher frog

Rana catesfeiana - The bullfrog

Rana clamitans - The green frog

Rana palerstris - Pickerel frog

Rana pipiens sphenocephala - Southern leopard frog

Salamanders

Ambyostoma maculatum - Spotted salamander

Ambyostoma opacum - Marbled salamander

Ambyostoma tigrinum tigrimim - Eastern tiger salamander

Desmognathus fuscus - Northern dusky salamander

Desmognathus monticola - Seal salamander

Eurycea bislineata - Two-lined salamander

Eurycea longeauda guttolineata - Three-lined salamander

Eurycea lucifuga - Cave salamander

Hemidactylium scutatum - Four-toed salamander

Gyrmophilus povshyriticus - Spring salamander

Plethodon dorsalis dorsalis - The zigzag salamander

Plethodon glutinosus glutimosus - Slimy salamander

Pseudotriton ruber - Red salamander

Necturus beyeri - Beyer's waterdog

otopthalmus viridescens viridescens - Red-spotted newt

Notopthalmus viridescens louisianensis - Central newt

Siren intermedia intermedia - Eastern lesser newt

Reptiles

Ophisaurus attenuatus longicaudus - Eastern slender grass lizard

Ophisaurus ventralis - Eastern glass lizard

Anolis carolinensis carolinensis - Green anole

Sceloporus undulatus hyacinthinus - Northern fence lizard

Sceloporus undulatus undulatus - Southern fence lizard

Eumeces anthracinus pluvialis - Southern coal skink

Eumeces anthracinus pluvialis - Southern coal skink

Eumeces egregius similis - Northern mole skink

Eumeces fasciatus - Five-lined skink

Eumeces inexysectatus - Southeastern five-lined skink

Eumeces laticips - Broad-headed skink

Scincilla laterale - Ground skink

Cnemidophorus sexlineatus sexlineatus - Eastern six-lined racerunner

Carphophis amoenus amoenus - Eastern worm snake

Cemophora coccinea copei - Northern scarlet snake

Colubar constrictor constrictor - Northern black racer

Colubar constrictor priapus - Southern black racer

Diadophis punctatus punctatus - Southern ringneck snake

Diadophis punctatus strictogenys - Mississippi ringneck snake

Elaphe guttata guttata - Corn snake

Elaphe obsoleta spiloides - Gray rat snake

Farancia erytrogramma erytrogramma - Rainbow snake

Heterodon platyrhinos - Eastern hognose snake

Heterodon simus - Southern hognose snake

Lampropeltis calligaster rhombomaculata - Mole snake

Lampropeltis getulers niger - Black kingsnake

Lampropeltis triangulum elapsoides - Scarlet kingsnake

Masticophis flagellum flagellum - Eastern coachwhip

Natrix erythrogaster flavigaster - Yellow-bellied water snake

Natrix erythrogaster erythrogaster - Red-bellied water snake

Natrix sipedon pleuralis - Midland water snake

Opheodrys aestivus - Rough green snake

Pituophis melanolecus melanoleucus - Northern Pine snake

Regina septemvittata - Queen snake

Storeria dekayi wrightorum - Midland brown snake

Storeria occipitomaculate occipitomaculata - Northern red-bellied snake

Tantilla coronata - Southeastern crowned snake

Thamnophis sauritus sauritus - Eastern ribbon snake

Thamnophis sirtalis sirtalis - Eastern garter snake

Virginia valeriae valeriae - Eastern smooth earthsnake

Micrurus fulvius fulvius - Eastern coral snake

Agkistrodon contortrix mokeson - Northern copperhead

Agkistrodon contortrix contortrix - Southern copperhead

Agkistrodon piscivorus piscivorus - Eastern cottonmouth

Crotalus horridus - Timber or canbrake rattlesnake

Sistrurus miliarius - Pigmy rattlesnake

Turtles (Reptiles)

Chelydra serpentina serpentina - Common snapping turtle

Macroclemys temmincki - Alligator snapping turtle

Graptemys geographica - Map turtle

Graptemys pulchra - Alabama map turtle

Pseudemys concinna concinna - River cooter

Pseudemys scripta elegans - Red-eared pond slider

Pseudemys scripta scripta - Yellow-bellied pond slider

Terrapene carolina carolina - Eastern box turtle

Terrapene carolina triungius - Three-toed box turtle

Kinostemon subrubrum subrubrum - Eastern mud turtle

Sternotherus minor peltifer - Stripe-necked musk turtle

Sternotherus minor depressus - Flattened musk turtle

Sternotherus odoratus - Common musk turtle or stinkpot

Trionyx spiniferus asper - Gulf coast spiney softshell

Table AI-8 - Rare and Endangered Species of the Upper Cahaba River Basin (Frey et al 1976 and Alabama Department of Conservation and Natural Resources, 1972).

Fish

	Status
Alosa alabamae - Alabama shad	Undetermined
Cottus carolinae impermatur - Lower Cahaba Lowland Sculpin	Rare
Notropis caeruleus - Blue shiner	Rare 1
Notropis uranoscopus - Skygazer shiner	Rare 1
Notropis sp. - Cahaba shiner	Endangered
Noturus munitus - Frecklebelly madtom	Endangered
Percina autolineata - Coldline darter	Endangered
Percina lenticula - Freckled darter	Rare 1
Scaphirynchus platorynchus - Shovelnose Sturgeon	Endangered

Amphibians and Reptiles

Desmognathus aeneus - Seepage salamander	Endangered
Plethodon cinereus spp. - Red-backed salamander	Rare 2
Pseudotriton montanus diastictus - Midland mud salamander	Rare 2
Farancia erytrogramma - Rainbow snake	Undetermined
Lampropeltis doliata syspila - Red milk snake	Rare 2

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*Note: Status defined as follows:

Rare 1 - A species which, although not presently threatened with extinction, is in such small numbers that it may be endangered if its environment worsens.

Rare 2 - A species that may be quite abundant where it does occur but is known in only a few localities or in a restricted habitat.

TABLE AI-9

CONCENTRATIONS OF MAJOR WATER QUALITY PARAMETERS IN THE STUDY AREA

River Mile Index	Sampling Period Beginning	Sampling Period Ending	Temperature Min. Mean Max.	pH Min. Mean Max.	DO No. Sampl.	DO Min. Mean Max. (mg/l)	BOD$_5$ (mg/l)		Org. N (mg/l)		NH$_3$ - N (mg/l)		NO$_2$ - N (mg/l)		NO$_3$ - N (mg/l)		TKN (mg/l)		NO$_2$+NO$_3$ (mg/l)		Total PO$_4$ (mg/l)		Ortho PO$_4$ (mg/l)		Total P (mg/l)	
							*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**
CAHABA RIVER																										
126.70	64/06/24	68/09/11	4-17.3-27	7.7											1	0.30					1	0.10				
	66/07/11	66/07/27	25.6°-28	7.2- 7.6- 8.4	12	5.0 7.4 9.0	11	1.6 2.2 3.7	1	0.40	3	0.10 0.27 0.40	1	0.009	1	0.10	2	0.40 0.46 0.51	2	0.12 0.13 0.14	3	0.20 0.22 0.26	3	0.09 0.15 0.20		
	72/08/21	72/09/08	25.6-28	7.2- 7.6- 8.4	15	5.2 5.7 6.2	15	0.2 1.6 4.2			5	0.05 0.15 0.29					5	0.15 0.42 0.60	5	0.47 0.64 0.77						
	74/01/01	76/06/08	9-17.8-25	6.7- 7.6- 8.1	28	5.7 8.2 11.1	28	0.8 2.0 3.6							23	0.14 1.23 8.90					23	0.05 0.2 0.85				
	76/10/28		11°	7.2	1	7.6	1	1.9			1	0.85					1	2.4	1	0.02	1	0.5				
129.20 NO DATA AVAILABLE																										
130.50	76/10/28		12.8	7.0	1	6.0	1	1.9			1	1.30					1	2.5	1	0.03	1	0.7				
136.50	76/10/28		11°	6.9	1	8.0	1	2.0			1	0.12					1	1.2	1	0.43	1	0.5				
137.40	66/07/11	66/07/27	26.4°	7.3	12	6.0 7.0 7.7	11	1.1 1.9 3.0																		
144.30	72/08/21	72/09/08	25.1-28		15	4.4 5.9 7.3	15	0.2 1.2 2.2			5	0.06 0.098 0.17					5	0.15 0.33 0.49	5	0.18 0.52 0.81					5	.05 .084 0.15
	74/01/01	76/05/19	18.7	7.5	29	7.00 9.25 12.00	29	.70 1.65 3.10							24	.00 .608 2.50					22	[illegible] [illegible] .307				
147.10	66/07/12	66/07/27	24-25-28	7.0- 7.6- 7.9	11	5.4 8.3 9.9	11	1.50 2.47 4.10																		
	67/03/28	68/09/11	23°	7.5- 7.6- 7.7																						
	76/10/28		14°	7.2	1	6.6	1	1.9			1	0.03					1	1.6	1	0.02	1	0.2				
149.60	70/10/23	76/03/25	5-15-28.5	5.1- 7.1- 7.6	8	5.9 8.8 11.8									12	0.00 0.53 3.40			1	0.48					1	0.06
	76/10/26		15.8	7.7	1	8.5	1	3.6			1	0.05					1	1.3	1	0.01	1	0.37				
152.80	72/08/21	72/09/08	21-23.4-26	7.0- 7.4- 7.8	15	5.1 6.5 7.6	15	0.9 1.5 3.0			5	0.01 0.05 0.12					5	0.25 0.318 0.40	5	0.65 1.2 1.76					5	0.160 0.274 0.57
	76/10/26		14.5	7.7	1	9.7	1	3.2			1	.005					1	1.4	1	0.01	1	0.10				
159.90	72/08/21	72/09/08	22-24-26	7.2- 7.5- 8.1	15	6.2 7.0 8.5	15	0.5 1.25 2.30			5	.03 .08 .16					5	0.25 0.402 0.60	5	0.66 1.46 2.20					5	0.18 0.248 0.31
	76/10/26		14.1	7.8	1	9.9	1	3.6			1	.005					1	1.3	1	0.5	1	0.10				

*Number of Samples

**Minimum, Mean and Maximum

TABLE AI-9 (Cont'd)

CONCENTRATIONS OF MAJOR WATER QUALITY PARAMETERS IN THE STUDY AREA

River Mile Index	Sampling Period Beginning	Sampling Period Ending	Temperature Min. Mean Max.	pH Min. Mean Max.	DO No. Sampl.	DO Min. Mean Max. (mg/1)		BOD_5 (mg/1)		Org. N (mg/1)		NH_3 - N (mg/1)		NO_2 - N (mg/1)		NO_3 - N (mg/1)		TKN (mg/1)		NO_2+NO_3 (mg/1)		Total PO_4 (mg/1)		Ortho PO_4 (mg/1)		Total P (mg/1)
CAHABA RIVER (Cont'd)																										
165.00	66/07/12	66/07/27	22-25.4-30		11	6.8 7.6 9.0	11	1.4 2.5 3.5																		
	08/21	72/09/08	22-25-30	7.1- 7.4- 8.0							5	0.21 0.09 0.03					5	0.55 0.39 0.14	5	1.90 1.11 0.61					5	0.27 0.22 0.16
	76/10/26		14.2	7.6	1	9.6	1	3.4			1	0.1					1	1.6	1	0.8	1	0.86				
173.40	66/07/12	66/07/27	21-24-29	7.2- 7.4- 7.8	11	6.9 7.8 9.1	11	1.5 3.9 6.2	1	0.5	3	0.40 0.33 0.30	1	0.01	1	1.0	2	0.78 0.76 0.74	2	1.32 1.22 1.12	3	1.66 1.36 1.01	3	1.14 0.87 0.65		
	72/08/21	72/09/08			14	5.1 6.2 8.1	15	1.10 3.25 5.8			5	0.13 0.23 0.48					5	0.40 0.87 1.41	5	0.74 2.28 4.40					5	1.31 0.65 0.33
	76/10/26		14.5	7.6	1	9.3	1	5.5			1	0.1					1	1.6	1	0.01	1	0.25				
176.60	/01/01	76/05/17	8-18-27	7- 7.5- 8	29	5.1 8.7 12.9	26	0.8 4.15 12.4							22	0.07 1.31 9.8					22	0.09 0.377 1.10				
	76/10/26		14.1	7.2	1	7.8	1	4.5			1	0.30					1	2.3	1	0.01	1	0.75				
180.40	6 /07/12	66/07/27	20-23-27	7.2- 7.5- 7.8	10	7.6 8.43 9.9	10	1.0 1.74 3.0																		
	7 /08/21	72/09/08	20-23-27	7.2- 7.5- 7.8	15	3.7 6.8 7.5	15	0.2 1.6 3.3			5	0.01 0.03 0.05					5	0.20 0.24 0.40	5	0.19 0.48 1.27					5	0.08 0.20 0.56
	76/10/28		14.2	7.6	1	8.5	1	1.9			1	.01					1	.9	1	.05	1	.75				
LITTLE CAHABA RIVER																										
1.20	66/07/13	66/07/27	21-22-23	7.3- 7.4- 7.6	10	7.5 7.9 8.3	10	2.0 2.51 3.10																		
	76/10/26		15°	7.7	1	9.5	1	5.4			1	0.05					1	1.2	1	0.01	1	0.10				
2.50	76/10/26		15°	7.7	1	8.0	1	3.5			1	0.05					1	1.3	1	0.01	1	0.10				
4.00	73/03/04	74/02/23									14	.015 0.21 0.81	14	.002 .009 .026	14	.062 .132 .224	14	0.20 0.826 2.94	14	0.70 0.14 0.23			14	0.016 0.046 0.099	14	0.016 .080 0.15
	76/10/26		16°	7.7	1	8.0	1	3.3			1	0.15					1	1.3	1	0.05	1	0.10				
4.50	No Date Available																									
7.40	66/07/12	66/07/27	22-27-32	7.6- 8.5- 9.6	11	8.3 10.2 12.1	10	2.2 2.8 4.5																		
	72/08/21	72/09/08	22-27-32	7.6- 8.5- 9.6	15	4.9 8.11 13.60	16	1.2 6.01 8.40			5	0.12 0.24 0.52					5	0.45 0.62 6.94	5	0.26 0.31 0.42					5	0.25 0.45 0.88

TABLE AI-9 (Cont'd)

CONCENTRATIONS OF MAJOR WATER QUALITY PARAMETERS IN THE STUDY AREA

River Mile Index	Sampling Period Beginning	Sampling Period Ending	Temperature Min. Mean Max.	pH Min. Mean Max.	DO No. Sampl.	DO Min. Mean Max. (mg/l)	BOD₅ (mg/l)		Org. N (mg/l)		NH_3 - N (mg/l)		NO_2 - N (mg/l)		NO_3 - N (mg/l)		TKN (mg/l)		$NO2+NO_3$ (mg/l)		Total PO_4 (mg/l)		Ortho PO_4 (mg/l)		Total P (mg/l)	
							*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**
LITTLE CAHABA RIVER (Cont'd)																										
9.40	72/08/21	72/09/08	21-22-24	7.5- 7.8- 8.8	15	4.90 6.02 7.00	15	0.80 2.46 6.8			5	0.10 0.335 0.63					5	0.30 0.65 1.05	5	0.38 0.54 0.78					5	0.32 0.80 1.74
	73/03/04	74/02/23									14	0.036 0.125 0.231	14	.004 0.14 0.40	14	0.29 0.47 0.70	14	0.20 0.726 1.76	14	0.30 0.485 0.740			13	.048 .214 .470	14	.075 0.309 0.66
	76/10/26		15°	7.7	1	6.5	1	4.6			1	.07					1	1.4	1	0.8			1	.40		
12.70	66/07/28	66/08/15	21-23-24	7.4- 7.6- 8.4	11	8.3 7.9 7.6	11	1.10 1.56 2.50																		
	66/07/12	72/09/08	20-22-26	7.1- 7.5- 7.9	26	2.6 4.9 8.0	26	.70 2.41 4.70	1	.30	8	.08 .35 .81	1	.01	1	.20	7	.250 .738 1.40	7	.130 .298 .460	3	.140 .766 1.88	3	.050 .096 1.40	5	.380 .843 1.35
	74/01/01	76/05/17	11-18.5-25	7.3- 7.6- 7.9	29	3.2 6.9 9.7	27	.80 3.93 9.0							24	.080 1.76 9.70					22	.070 .429 .85				
	68/11/01		17	8.3																						
13.70	76/10/26		15°	7.5	1	4.9	1	13.5			1	0.20					1	1.3			1	.50				
15.60	72/08/21	72/09/08	17-21-23	7.4- 7.6- 7.8	15	4.70 5.93 7.10	15	.60 1.55 4.20			5	.030 1.58 .380					5	.100 .396 .850	5	.250 .452 .860					5	.090 .348 .750
	76/10/26		14°	7.6	1	6.7	1	3.1			1	0.07					1	0.9	1	0.35	1	0.2				
16.60	76/10/26		15°	7.6	1	5.7	1	3.6			1	0.05					1	0.9	1	0.40	1	0.2				
16.70	72/08/21	72/09/08	19-21-23	7.4- 7.6- 7.8	15	4.70 5.93 7.10	15	0.60 1.55 5.20			5	0.030 0.158 0.380					5	0.10 0.396 0.850	5	0.25 0.452 0.86					5	0.090 0.348 0.750
	76/10/26		14.2	7.5	1	6.1	1	4.1			1	0.05					1	1.4	1	0.45	1	0.2				
BUCK CREEK																										
0.00	76/10/28		12°	7.3	1	10.2	1	8.4			1	0.08					1	1.4	1	0.03	1	0.25				
1.80	76/10/28		12.5°	7.5	1	10.4	1	1.1			1	0.05					1	1.4	1	0.11	1	0.25				
2.30	74/01/01	76/04/15	6.5-18-28	7.2- 7.6- 8.0	28	5.80 8.00 11.00	28	0.20 1.83 3.40							21	0.17 1.01 6.7					20	0.06 0.36 2.10				
4.50	66/07/11	66/07/27	21-22.7-24	7.1- 7.3- 7.5	12	4.90 6.30 7.60	12	0.90 2.14 4.60	1	0.20	2	0.20 0.20 0.20	1	0.01	1	0.4	1	0.38	1	0.36	3	0.70 0.74 0.80	3	0.53 0.60 0.68		
	76/10/28		11.5°	7.3	1	7.6	1	2.9			1	0.18			1	1.6	1	0.86			1	0.62				
6.00	66/07/11	66/07/27	21-21-23	7.2- 7.3- 7.5	12	4.50 5.65 6.50	11	2.70 5.82 11.0			1	0.22					1	0.32	1	0.44						
	76/10/28		12.5	7.4	1	7.5	1	1.5			1	0.01					1	1.1	1	0.54	1	1.0				

*Number of Samples

**Minimum, Mean and Maximum

TABLE AI-9 (Cont'd)

CONCENTRATIONS OF MAJOR WATER QUALITY PARAMETERS IN THE STUDY AREA

River Mile Index	Sampling Period Beginning	Sampling Period Ending	Temperature Min. Mean Max.	pH Min. Mean Max.	DO No. Sampl.	DO Min. Mean Max. (mg/1)	BOD$_5$ (mg/1)		Org. N (mg/1)		NH_3 - N (mg/1)		NO_2 - N (mg/1)		NO_3 - N (mg/1)		TKN (mg/1)		NO_2+NO_3 (mg/1)		Total PO_4 (mg/1)		Ortho PO_4 (mg/1)		Total P (mg/1)	
							*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**
BUCK CREEK (Cont'd)																										
6.8	76/10/28		12.0	7.4	1	8.6	1	1.2			1	0.01					1	0.9	1	0.77	1	0.1				
PATTON CREEK																										
0.20	76/10/28		12.0	7.1	1	5.7	1	14.7			1	5.3					1	8.0	1	0.10	1	2.1				
0.70	66/07/11	66/7/27	25-28-31	7.0- 7-4- 7.9	12	2.50 3.41 6.50	12	2.00 5.09 7.60	1	0.90 .62 .70	3	.50	1	0.008	1	0.30	2	1.74 1.84 1.94	2	0.90 0.175 0.26	3	2.91 3.48 4.33	3	2.18 2.63 2.98		
1.00	74/01/01	75/12/22	8-19-28	6.1- 7.5- 8.8	24	1.90 6.31 15.20	22	1.20 11.48 31.50							17	0.25 1.14 2.61					20	0.204 1.33 3.22				
3.20	NO DATA AVAILABLE																									
BIG BLACK CREEK																										
0.00	76/10/26		13.5	7.3	1	7.45	1	3.0			1	0.15					1	1.0	1	0.1	1	0.20				
1.90	67/23/29	67/11/02	NO PERTINENT DATA																							
COX CREEK																										
-	73/03/04	74/02/23									13	0.005 0.056 0.30	13	0.001 0.001 0.005	13	0.010 0.048 0.136	13	0.100 1.127 4.60	13	0.010 0.049 0.136			13	.005 .015 .039	13	.005 .052 .215
UNNAMED CREEK (to Lake Purdy)																										
-	73/03/04	74/02/23									8	.010 .064 .315	8	.001 .011 .072	8	.008 .024 .048	8	.100 .57 2.10	8	.008 .035 .115			8	.005 .056 .270	8	.005 .011 .035
CAHABA VALLEY CREEK																										
0.00	76/10/26		12.7	7.4	1	9.2	1	1.0			1	0.05					1	1.0	1	0.02	1	0.05				
-	66/07/11	66/07/27	23-24-26	7.5- 7.6- 7.8	12	5.20 7.30 8.10	12	0.60 1.66 2.50																		
LITTLE SHADES CREEK																										
-	76/10/28		10°	7.0	1	9.0	1	3.5			1	0.06					1	1.3	1	0.01	1	0.10				
STINKING CREEK																										
-	76/10/26		13.8	7.2	1	8.25	1	3.6			1	0.1					1	0.8	1	0.01	1	0.10				
LITTLE CAHABA CREEK																										
-	76/10/26		13°	7.5	1	9.2	1	3.0			1	0.01					1	1.1	1	0.05	1	0.10				
PINCHGUT CREEK																										
-	76/10/26		14.5	7.5	1	9.4	1	7.9			1	0.01					1	0.8	1	0.6	1	0.3				
PEAVINE CREEK																										
-	76/10/28		12.0	7.3	1	10.1	1	0.7			1	0.01					1	2.3	1	0.01	1	0.05				

*Number of Samples

**Minimum, Mean and Maximum

TABLE AI-9 (Cont'd)

CONCENTRATIONS OF MAJOR WATER QUALITY PARAMETERS IN THE STUDY AREA

River Mile Index	Sampling Period Beginning	Sampling Period Ending	Temperature Min. Mean Max.	pH Min. Mean Max.	DO No. Sampl.	DO Min. Mean Max. (mg/l)	BOD$_5$ (mg/l)		Org. N (mg/l)		NH_3 - N (mg/l)		NO_2 - N (mg/l)		NO_3 - N (mg/l)		TKN (mg/l)		NO_2+NO_3 (mg/l)		Total PO_4 (mg/l)		Ortho PO_4 (mg/l)		Total P (mg/l)	
							*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**
PRAIRIE BROOK																										
-	76/10/28		10.9	7.5	1	10.4	1	0.8			1	0.01					1	1.0	1	0.01	1	0.10				
LAKE PURDY AT 11501																										
Depth																										
0	73/03/19	73/11/02									3	0.04					3	0.80	3	0.03			3	0.01	3	0.05
5	73/03/19	73/11/02			3	6.6 8.33 9.6					3	0.06 0.12 0.23					3	0.40 0.73 1.30	3	.06 .11 .14			3	0.01 0.02 0.06	3	.06 .07 .10
10-13	73/03/19	73/11/02			2	1.2 4.90 8.6					2	0.07 0.20 0.33					2	0.40 0.65 0.90	2	0.11 0.13 0.14			2	0.014 0.037 0.060	2	0.06 0.08 0.10
LAKE PURDY AT 11502																										
0	73/09/19	73/11/02			-						3	.03 .09 .20					3	.80 1.13 1.60	3	.03 .08 0.18			3	.009 .010 .012	3	.03 .047 .06
5-6					3	3.10 7.23 10.40					3	.03 .07 .13					3	.20 .507 .80	3	.050 .047 .060			3	.012 .016 .022	3	.03 .047 .06
10-12					2	9.0 8.75 10.4					2	.03 .035 .04					2	.20 .45 .70	2	.03 .03 .03			2	.009 .012 .014	2	.03 .045 .06
15					2	0.0 3.9 7.8					2	.031 .036 .040					2	.80 .80 .80		.03 .08 .13			2	.007 .017 .026	2	.05 .05 .05
18-20					2	7.6 8.10 8.7					2	.040 .045 .050					2	.20 .40 .60	2	.03 .05 .08			2	.011 .0126 .014	2	.04 .045 .05
25					2	0.0 3.7 7.4					2	.056 .058 .060					2	.20 .55 .90	2	.09 .10 .11			2	.016 .035 .051	2	.03 .07 .11
28	73/09/19	73/11/02			1	7.4					1	0.06					1	0.60	1	0.04			1	0.013	1	0.06
35					2	0.0 2.3 4.6					2	.07 .84 1.61					2	0.20 1.30 2.40	2	.007 .011 .015			2	.025 .047 .067	2	0.05 0.165 0.28
40					1	0.40					1	1.46					1	2.10	1	0.05			1	0.82	1	0.14
45					1	4.4					1	0.08					1	0.30	1	0.11			1	0.026	1	0.05
LAKE PURDY AT 11503																										
0	73/03/19	73/11/02			2	7.8 8.8 8.8					3	0.04 0.097 0.20					3	0.40 0.833 1.50	3	.04 .077 0.14	3	.006 .001 .014			3	.03 .033 .04
6					2	1.2 4.5 7.9					2	0.03 0.115 0.20					2	0.20 0.055 0.90	2	0.04 0.075 0.11	2	.013 .0135 .014			2	.03 .035 .04
12					1	8.8					1	0.04					1	0.20	1	0.05			1	.013	1	0.04

*Number of Samples

**Minimum, Mean and Maximum

Sources: USEPA-STORET, USGS, AWIC, Birmingham Planning Commission (208 agency).

TABLE AI-10

WATER USE CLASSIFICATIONS

CLASSIFICATIONS OF INTRASTATE WATERS OF THE CAHABA RIVER BASIN ADOPTED BY THE WATER IMPROVEMENT COMMISSION AND APPROVED BY EPA EFFECTIVE 15 FEB 78

Stream	From	To	Public Water Supply	Swimming	Fish and Wildlife	Agricultural and Industrial Water Supply
Cahaba River	Alabama River	** Junction of Lower Little Cahaba River		X		
Cahaba River	** Junction of Lower Little Cahaba River	Dam near U. S. Highway 280			X	
Cahaba River	Dam near U. S. Highway 280	Grant's Mill Road	X			
Cahaba River	Grant's Mill Road	U. S. Highway 11			X	
Cahaba River	U. S. Highway 11	its source			X	
Childers Creek	Cahaba River	its source			X	
Oakmulgee Creek	Cahaba River	its source		**X		
Little Oakmulgee	Oakmulgee Creek	its source		**X		
Rice Creek	Cahaba River	its source			X	

TABLE AI-10

INTRASTATE WATERS OF THE CAHABA RIVER BASIN

Stream	From	To	Public Water Supply	Swimming	Fish and Wildlife	Agricultural and Industrial Water Supply
Waters Creek	Cahaba River	its source		**X		
Old Town Creek	Cahaba River	its source		**X		
Blue Outtee Creek	Cahaba River	its source		**X		
Affonee Creek	Cahaba River	its source		**X		
Haysop Creek	Cahaba River	its source			X	
Schultz Creek	Cahaba River	its source		**X		
Little Cahaba River	Head of Lake Purdy	its source (junction of Mahan and Shoal Creeks)			X	
Sixmile Creek	Little Cahaba River	its source		**X		
Mahan Creek	Little Cahaba River	its source			X	
Shoal Creek	Little Cahaba River	its source			X	
Caffee Creek	Cahaba River	its source			X	
*Shades Creek	Cahaba River	Jefferson County Line			X	

TABLE AI-10

INTRASTATE WATERS OF THE CAHABA RIVER BASIN

Stream	From	To	Public Water Supply	Swimming	Fish and Wildlife	Agricultural and Industrial Water Supply
Shades Creek	Jefferson County Line	Shades Creek STP				X^1
*Shades Creek	Shades Creek Sewage Treatment Plant	its source			X	
Rocky Brook	Shades Creek	its source			X	
Buck Creek	Cahaba River	Cahaba Valley Creek			X	
Buck Creek	Cahaba Valley Creek	its source				X^1
Cahaba Valley Creek	Buck Creek	its source			X	
Peavine Creek	Buck Creek	its source			X	
Oak Mountain State Park Lakes				X		
Patton Creek	Cahaba River	its source				X^1
Little Shades Creek	Cahaba River	its source			X	

[1] Although classifications remain the same for some segments, criteria applicable to classifications have been upgraded.

TABLE AI-10

INTRASTATE WATERS OF THE CAHABA RIVER BASIN

Stream	From	To	Public Water Supply	Swimming	Fish and Wildlife	Agricultural and Industrial Water Supply
Little Cahaba River (Jefferson-Shelby Counties)	Cahaba River	Head of Lake Purdy	X			
Little Cahaba River (Jefferson County)	Head of Lake Purdy	Corporate Limits, City of Leeds			X[1]	
Little Cahaba River (Jefferson County)	Corporate Limits, City of Leeds	its source			X[1]	
Pinchgut Creek	Cahaba River	its source			X[1]	

**Amended on June 18, 1973, in accordance with a public hearing conducted on May 3, 1973.

***Amended on October 16, 1972, in accordance with a public hearing conducted on September 18,1972.

Table AI-11 Probable Aquatic Plants Of The Cahaba River

Common cattail	*Typha lalifolia*
*Bur-reed	*Sparganium americanum*
Pondweeds	*Potamogetan* spp.
*Pondweed	*Potanogetan americanus*
Horned pondweeds	*Zannichellia palustris*
Pipewort	*Eriocaulon compressum*
Naiads	*Najas* spp.
Mermaid weed	*Proserpinaca* spp.
Water parsnip	*Sium suave*
Dropwort	*Oxyopolis* spp.
Water violet	*Hottonia inflata*
	Gratiola virginiana
False pumpernel	*Lindermia dubia*
Bladderwort	*Utricularis* spp.
Water fern	*Azolla carolinana*
Rush	*Juncus* spp.
Water plantain	*Alisma plantago* - *aquatica*
	Mayaca spp.
Burheads	*Echmodorus radicans*
Yellow-eyed grass	*Xyris* spp.
Arrowhead	*Sagittario* spp.
Wild celery	*Vallisneria americana*
Manna grass	*Glyceria* spp.
Cut grass	*Leersia* spp.
	Papsalum spp.
Wild rice	*Zigania aquatica*
Spike rush	*Eleocharis* spp.
Bulrush, club rush	*Scorpus* spp.
*Arrow arum	*Peltandra virginica*
Duckweed	*Lemna minor*
Great duckweed	*Spirodela polyrhiza*
	Wolffia columbiana
Smartweed knotweed	*Polygonum* spp.
*Smartweed	*Polygonum hydropiperoides*
*Alligator weed	*Alternanthera philoxeroides*
Hornwort	*Cerotophyllum* spp.
*Coontail	*Ceratopayllum demersum*
Water shield	*Brasenia schreberi*
	Cabomba carcliniana
Yellow water lily, spatterdock	*Myshar advena*
White water lily	*Nymphaea odorata*
Water starwort	*Callitriche heterophylla*
Swamp loosestrife	*Decodon verticillatus*
Primrose willow	*Jussiaea* spp.

Table AI-11 (Cont'd)

*False loosestrife	*Ludvigia* spp.
*Elodea	*Anacharis occidentalis*
*Aquatic moss	*Fisidens*
*Lizards tail	*Saurus cernuus*
*Yellow water lily	*Nuphar*
*Water willow	*Justicia americana*
*Spider lily	*Hymenocallis*
*River weed	*Podostomum*

ALGAE

Filamentous green	*Cladophora*
Filamentous green	*Rhizoclonium*
Filamentous green	*Stigeoclonium*
Filamentous green	*Ulothrix*
Filamentous green	*Spirogyra*
Filamentous green	*Mougeotia*
Filamentous green	*Diatoms*
Filamentous blue-green	*Microcoleus* sp.
Other bluegreens	

Table AI-12 A List Of Invertebrates Collected From Twelve Sections Of The Upper Cahaba River In September 1976 (Frey et al 1976)- Refer to Figure 1.2

	Section											
ORGANISM	1	2	3	4	5	6	7	8	9	10	11	12
Porifera												
Spongillidae												
Spongilla sp.										x		
Turbellaria									x			
Planariidae	x		x									
Bryozoa												
Lophopodidae												
Pectinatalla magnifica												x
Oligochaeta												
Naididae												
Nais variabilis				x	x	x	x	x			x	x
Stylaria lacustris					x							
Tubificidae												
Branchiura sowerbyi			x		x	x	x	x			x	x
Limnodrilus hoffmeisteri					x							
Isopoda												
Asellidae												
Asellus sp.												x
Lirceus sp.		x	x									x
Amphipoda												
Gammaridae												
Crangonyx sp.												x
Decapoda												
Astacidae												
Cambarinae			x									
Fallicambarus sp.		x										
Orconectes jeffersoni	x				x	x	x	x			x	x
O. virilis									x			
O. sp.					x	x	x	x			x	x
Hydracarina		x										
Ephemeroptera												
Ephemerellidae												
Ephemerella sp.		x										
Ephemeridae												
Hexagenia sp.				x							x	x

Table AI-12 (Cont'd)

	Section											
ORGANISM	1	2	3	4	5	6	7	8	9	10	11	12
Ephemeroptera												
Baetidae												
Tricorythodes sp.					x	x					x	x
Pseudocloeon sp.				x		x						
Baetis sp.		x	x	x	x	x		x	x			x
Siphlonuridae												
Isonychia sp.		x	x		x		x		x			
Heptagenidae												
Stenonema sp.		x	x	x	x	x	x		x	x	x	x
Odonata												
Gomphidae												
Hagenius sp.					x		x					
Dromogomphus sp.						x	x				x	
Lanthus sp.		x										
Aeschnidae												
Basiaeschna sp.		x										x
Epiaeschna sp.		x										
Boyeria vinosa			x				x	x			x	x
Aeschna sp.	x	x	x	x								
Macromiidae												
Didymops sp.					x	x		x				
Macromia sp.		x		x		x		x				x
Coenagrionidae												
Ischnura sp.		x	x	x	x							x
Enallagma sp.				x								
Chromagrion sp.					x							
Argia sp.		x		x	x	x	x	x	x	x	x	x
Calopterygidae												
Hetaerina sp.												
Calopteryx sp.	x					x	x	x				
Hemiptera												
Hydrometridae												
Hydrometra sp.			x									
Gerridae					x	x						
Gerris sp.			x									
Veliidae		x									x	
Mesoveliidae												
Mesovelia sp.												x
Nepidae												
Ranatra sp.								x			x	
Plecoptera												
Peltoperlidae												
Peltoperla sp.		x										

Table AI-12 (Cont'd)

ORGANISM	Section 1	2	3	4	5	6	7	8	9	10	11	12
Plecoptera												
Perlidae												
Acroneuria sp.	x	x	x									
Paragnetina sp.			x									
Megaloptera												
Corydalidae												
Corydalus cornutus		x	x	x	x	x	x	x	x		x	x
Chauliodes sp.	x	x										
Coleoptera												
Haliplidae												
Peltodytes sp.		x					x					
Hydrophilidae												
Tropisternus sp.				x								
Psephenidae												
Psephenus herricki		x	x	x		x						
Ectopria sp.											x	
Dryopidae												
Dryops sp.		x	x		x			x			x	
Elmidae												
Stenelmis sp.		x							x		x	x
Dubiraphia sp.							x					x
Macronychus glabratus		x	x	x	x		x	x		x		x
Ancyronyx variegatus		x										x
Zaitzevia parvula		x		x								
Ptilodactylidae												
Anchytarsus bicolor	x						x					
Trichoptera												
Philopotamidae												
Sortosa sp.								x				
Chimarra sp.	x	x			x			x	x			
Hydropsychidae												
Hydropsyche sp.	x	x	x	x	x	x	x	x	x			x
Cheumatopsyche sp.	x	x	x	x								
Hydroptilidae												
Leucotrichia sp.		x										
Hydroptila sp.						x	x	x				x
Leptoceridae												
Athripsodes sp.		x										
Helicopsychidae												
Helicopsyche sp.		x										
Diptera												
Chironomidae												
Ablabesmyia sp. (*janta*-p*arajante*)								x		x		x
A. mallochi					x	x	x	x		x	x	x
Conchapelopia sp.											x	x
Natarsia sp.						x						
Pentaneura sp.											x	
Labrundinia johannseni					x							
L. neopilosella										x		

Table AI-12 (Cont'd)

ORGANISM	Section 1	2	3	4	5	6	7	8	9	10	11	12
Diptera												
Chironomidae												
Procladius sublettei					x			x				
Corynoneura taris					x					x		
Thienemanniella sp. 2(Roback)				x	x	x						
Orthocladius cariatus						x	x					
O. (*thienemanniella?*)												x
Cardiocladius sp.						x	x	x				
Cricotopus (*bicinetus* gp)				x		x	x	x				x
C. (*slossonae?*)							x	x				
Cricotopus (*exilis?*)							x					
Microcricotopus (*alternantherae*)											x	
Rheocricotopus sp.								x				
Chironomus attenuatus											x	x
C. crassicaudatus										x		
Dicrotendipes modestus					x							x
D. neomodestus							x			x	x	x
Glyptotendipes (*meridionalis?*)					x							
Parachironomus carinatus					x							
Paracladopelma sp.?												x
Cryptochironomus (*fulvus* gp) sp.							x					
C. ponderosus						x						
C. sp.											x	
Endochironomus sp.					x					x		
Phaenopsectra (*flavipes* gp) sp.		x			x							
P. (*obediens* group) sp.										x		
Tribelos (*juncundus?*)					x							
T. sp.					x		x				x	
Polypedilum illinoense		x	x	x	x			x		x	x	x
P. nr. *illinoense* Roback '53		x		x				x		x		
P. parascalaenum						x						x
P. fallax				x	x	x		x			x	
Tanytarsus (*flavellus?*)							x				x	x
T. sp. 2												x
Micropsectra sp. 7 Roback '57						x						
Cladotanytarsus sp. (nr. sp. 2 Roback '57) var. 4						x						
C. sp. (nr. sp. 2 Roback '57) var. 6						x						
Rheotanytarsus exiguus					x	x				x		
R. sp. 3		x										
Ceratopogonidae								x				
Palpomyia? sp. 1					x							
P. sp. 3		x										
Undetermined possible *Palpomyia*					x							
Simulidae												
Simulium vittatum						x		x				
S. (*tuberosum?*)		x	x	x					x			
Undetermined genus & sp.										x		
Tipulidae												
Tipula sp.		x										
Antocha sp.		x				x						

Table AI-12 (Cont'd)

ORGANISM	Section											
	1	2	3	4	5	6	7	8	9	10	11	12
Culicidae												
Anopheles sp.		x										
Rhagionidae												
Atherix variegata		x										
Mollusca												
Gastropoda												
Physidae												
Physa sp.	x				x		x	x			x	x
Planorbidae												
Helisoma sp.		x										
Viviparidae												
Campeloma sp.					x	x	x	x			x	x
Pleuroceridae												
Pleurocera sp.	x											
Goniobasis sp.	x	x	x	x	x	x	x	x	x		x	x
Pelecypoda												
Unionidae												
Fusconia rubida					x	x					x	x
Quadrula asperata				x					x			
Q. metaneura						x						
Tritogonia vernucosa					x	x	x	x				
Ptychobranchus greeni				x								
Elliptio crassidens				x	x	x	x	x	x	x	x	x
E. arctatus				x								
Obliquaria reflexa									x			
Leptodea fragilis					x							
Ligumia recta					x	x			x	x		
Villosa sp.					x	x	x	x				
Lampsilis excavata					x	x	x	x				
Amblema perplicata				x	x	x	x	x	x	x	x	x
Potamilus purpuratus									x	x		
Lampsilis claibornensis									x			x
Sphaeriidae												
Sphaerium sp.						x		x				
Corbiculidae												
Corbicula manilensis			x	x	x	x	x	x	x	x	x	x
TOTAL TAXA	13	45	24	32	51	46	38	41	18	20	37	48

Table AI-13 - Mussels from the Upper Cahaba River (Frey et al 1976)

Organisms	Study 1	Study 2	Study 3
Amblema perplicata	x	x	x
Anadonta imbecillis	x	x	
Carunculina carvunculus	x		
Dysnomia metastriata	x	x	
Elliptio arctatus	x	x	x
Elliptio crassidens	x	x	x
Fusconaia rubida		x	x
Lampsilis anodontoides		x	
Lampsilis clarkiana	x	x	
Lampsilis excavata	x	x	x
Lampsilis claibornensis		x	
Lasmigona holstonia	x	x	
Leptodea fragilis		x	x
Ligumia recta		x	x
Medionidus acutissimus	x	x	
Obliquaria reflexa		x	x
Pleurobema decisum		x	
Pleurobema nux	x		x
Potamilus purpuratus		x	
Ptychobranchus greeni	x	x	
Quadrula aspera		x	x
Quadrula asperata	x	x	x
Quadrula rumphiana		x	
Strophitus subvexus	x		
Tritongonia verrucosa	x	x	x
Villosa lienosa	x	x	x
Villosa nebulosa	x	x	
Villosa vibex	x		
Corbicula leana	x	x	x

Study 1 - 1938 study by Van Der Schalie
Study 2 - 1973 study by Baldwin
Study 3 - 1976 EPA study

TABLE AI-14
LOCATIONS AND DESCRIPTIONS OF STATIONS
CAHABA RIVER SUB-BASIN

Station	County	State	Location	Description
014495	Jefferson	Ala.	Cahaba River - (river mile 173) at U.S. Hwy. 11 above the Trussville Sewage Treatment Plant outfall.*	Stones, pebbles, gravel, sand, silt. Width - 50 ft. Current - swift. Temp. - 14.5°C. Sampling depth - 1 ft.
014480	Jefferson	Ala.	Cahaba River - (river mile 160) at U.S. Hwy. 78.	Pebbles, gravel, sand, silt. Width - 50 ft. Current - swift. Temp. - 16.0°C. Sampling depth - 1 ft.
014475	Jefferson	Ala.	Cahaba River - (river mile 144) at Jefferson County Hwy. 60 just south of Cahaba Heights.	Stones, pebbles, gravel, sand, mud. Width - 80 ft. Current - slow. Temp. - 18.0°C. Sampling depth - 10 ft.
014470	Jefferson	Ala.	Little Cahaba River - at Jefferson County Hwy. 72, 13 miles above confluence with Cahaba River (river mile 142).	Pebbles, stones, sand, silt. Width - 40 ft. Current - swift. Temp. - 17.5°C Sampling depth - 1 ft.
014465	Jefferson	Ala.	Little Cahaba River - in Purdy Lake at Jefferson County Hwy. 143, 7 miles above confluence with Cahaba River.	Mud, clay, silt. Width - 500 ft. Current - moderate. Temp. - 18.0°C. Sampling depth - 20 ft.
014450	Jefferson-Shelby	Ala.	Little Cahaba River - at county road south of Cahaba Heights about one mile above confluence with Cahaba River.	Stones, pebbles, gravel, sand. Width - 30 ft. Current - swift. Temp. 13.5°C. Sampling depth - 1 ft.
014430	Jefferson	Ala.	Patton Creek - at Ala. Hwy. 150 about one mile above confluence with Cahaba River (river mile 132).	Pebbles, stones, gravel, sand, silt. Width - 25 ft. Current - swift. Temp. - 17.0°C. Sampling depth - 1 ft.
014410	Shelby	Ala.	Buck Creek - at Shelby County road about one mile above confluence with Cahaba Valley Creek.	Stones, pebbles, gravel, silt. Width - 35 ft. Current swift. Temp. - 18.5°C. Sampling depth - 2 ft.
014405	Shelby	Ala.	Cahaba Valley Creek - near railroad bridge northeast of Helena about one mile above confluence with Cahaba River (river mile 127).	Stones, pebbles, gravel, sand, silt. Width - 50 ft. Current - swift. Temp. - 20.0°C. Sampling depth - 1 ft.
014400	Shelby	Ala.	Cahaba River - (river mile 124) at Shelby county road about 2 miles south of Helena.	Pebbles, gravel, sand, silt. Width - 120 ft. Current - swift. Temp. - 19.5°C. Sampling depth - 1 ft.
014370	Jefferson	Ala.	Shades Creek - at Ala. Hwy. 149, 42 miles above confluence with Cahaba River (river mile 105).	Sand, pebbles, silt. Width - 30 ft. Current - swift. Temp. - 25.5°C. Sampling depth - 2 ft.
014340	Jefferson	Ala.	Shades Creek - at Jefferson county road about 2 miles southwest of Bessemer 24 miles above confluence with Cahaba River.	Sand, silt. Width - 30 ft. Current - moderate. Temp. - 18.0°C. Sampling depth - 2 ft.
014285	Shelby	Ala.	Shoals Creek - a short distance north of Ala. Hwy. 25 just north of Shelby county line 13 miles upstream from confluence with Little Cahaba River.	Stones, pebbles, gravel, sand, silt. Width - 40 ft. Current - swift. Temp. 16.0°C. Sampling depth - 1 ft.
014270	Bibb	Ala.	Little Cahaba River - at Ala. Hwy. 33, 13 miles above junction with Cahaba River (river mile 92).	Pebbles, gravel, sand, silt. Width - 100 ft. Current - moderate. Temp. - 18.0°C. Sampling depth - 4 ft.
014180	Bibb	Ala.	Cahaba River - (river mile 69) at Bibb county road about 6 miles southwest of Brent.	Sand, silt. Width - 125 ft. Current - swift. Temp. - 19.5°C. Sampling depth - 3 ft.
014140	Perry	Ala.	Rice Creek - at Perry county road about 6 miles southeast of Marion about one mile upstream from junction with Cahaba River (river mile 36).	Sand, silt. Width - 25 ft. Current - swift. Temp. - 18.5°C. Sampling depth - 1 ft.
014130	Perry	Ala.	Cahaba River - (river mile 32) at Ala. Hwy. 43.	Sand, pebbles, stones, gravel, silt. Width - 150 ft. Current - swift. Temp. - 19.5°C. Sampling depth - 2 ft.

*Zero reference is confluence of Cahaba River with Alabama River.

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Table AI-15

Pollution Sensitive Forms - Macroscopic Invertebrate Organisms - Cahaba River Basin (USDI 1967)

ORGANISMS	STATIONS AND NUMBERS OF ORGANISMS COLLECTED																
	014495	014480	014475	014470	014465	014450	014430	014410	014405	014400	014370	014340	014285	014270	014180	014140	014130
Clams																	
Unionidae	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stonefly nymphs																	
Acroneuria	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	12
Atoperla	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isogenus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Isoperla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-
Nemoura	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-
Perlesta	4	13	-	-	-	2	-	-	5	-	-	-	2	-	-	4	4
Phasganophora	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Mayfly nymphss																	
Baetis	-	-	-	-	-	5	-	-	2	-	-	-	-	30	-	-	8
Caenis	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Callibaetis	-	-	-	-	18	-	-	-	-	-	-	-	-	-	-	-	-
Centroptilum	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Ephemerella	2	1	1	-	-	72	-	10	3	-	-	-	11	2	15	-	2
Heptagenia	-	-	-	-	-	-	-	-	-	-	-	-	12	-	-	-	17
Isonychia	12	8	-	-	-	4	-	-	1	-	-	-	-	-	-	-	1
Pseudocloeon	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stenonema	49	24	15	-	-	49	-	16	57	40	-	76	64	21	-	10	28
Caddisfly larvae																	
Caborius	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cheumatopsyche	2	8	-	-	-	4	4	5	15	1	-	-	4	-	-	-	105
Chimarra	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Drusinus	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydropsyche	6	2	-	-	-	35	-	1	8	1	-	-	-	-	-	-	13
Macronemum	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycentropus	-	1	-	-	-	-	-	3	-	-	-	-	-	9	-	-	-
Damselfly nymphs																	
Argia	-	-	9	-	-	-	-	1	1	6	1	1	-	-	23	-	-
Hellgrammites																	
Corydalus	6	3	1	-	-	2	-	2	2	3	-	-	1	-	1	2	-
Fishfly larvae																	
Chauliodes	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alderfly larvae																	
Sialis	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Beetle larvae																	
Psphenus	2	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-
Elmidae	63	-	6	-	-	10	-	7	19	2	-	1	-	-	3	1	2
Blackfly larvae																	
Simulium	-	44	2	-	1	5	235	2	9	500	-	4	39	-	-	-	18

TABLE AI-16
POLLUTION TOLERANT FORMS - MACROSCOPIC INVERTEBRATE ORGANISMS
CAHABA RIVER BASIN (USDI 1967)

Organisms	Stations and Numbers of Organisms Collected														
	014495	014480	014475	014470	014465	014450	014430	014410	014405	014400	014370	014340	014285	014270	014180
Flatworms															
Planariidae	-	2	-	-	-	-	18	-	1	-	-	-	-	2	-
Segmented worms															
Branchiura sowerbyi	-	4	2	-	-	-	8	-	-	-	-	3	-	4	2
Other Oligochaeta	-	5	12	-	45	10	231	29	-	3	53	48	31	151	120
Leeches															
Hirudinea	-	-	-	-	6	-	-	-	-	1	-	5	1	-	-
Snails															
Ferrissia	12	-	-	-	-	-	-	-	-	-	-	-	2	-	1
Physa	2	1	-	-	9	-	11	-	-	-	-	-	2	-	2
Other Pulmonata	8	-	2	-	6	-	-	-	-	4	-	-	-	-	1
Prosobranchia	-	23	3	-	-	8	-	1	4	11	-	-	4	5	5
Clams															
Corbicula	-	-	-	-	-	-	-	-	-	-	-	17	-	-	-
Sphaeriidae	-	1	-	-	47	-	-	-	-	-	-	-	-	6	-
Crayfishes															
Cambarus extraneus	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Cambarus jordani	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Cambarus latimanus	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Cambarus striatus	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-
Orconectes sp.	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Procambarus clarkii	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Procambarus spiculifer	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Procambarus sp.	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Scuds															
Gammarus	-	-	-	-	1	-	-	-	-	-	-	9	-	-	-
Hyalella	-	-	-	-	1	-	101	-	-	-	-	13	-	-	-
Sowbugs															
Asellus	-	14	-	-	-	-	-	6	-	-	-	38	1	1	-
Lirceus	17	-	-	-	-	14	-	-	17	-	-	-	-	-	-
Dragonfly nymphs															
Aeshna	-	-	-	-	-	1	-	1	-	-	-	-	1	-	-
Celithemis	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Didymops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dromogomphus	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Gomphus	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
Libellula	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Ophiogomphus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perithemis	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Plathemis	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Sympetrum	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Tetragoneuria	-	-	-	-	-	-	-	-	5	5	-	-	-	-	-
Damselfly larvae															
Agrion	-	-	-	-	-	-	-	4	-	1	-	-	-	-	-
Calopteryx	-	-	-	-	-	-	-	3	-	-	11	-	2	-	-
Enallagma	-	-	-	-	9	-	-	-	-	-	-	6	-	-	-
Ischnura	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Midge larvae															
Chironomidae	-	35	23	-	103	244	549	169	50	488	58	30	170	133	[illegible]
Biting Midge larvae															
Ceratopogonidae	-	-	-	-	81	-	-	-	-	-	-	-	-	6	[illegible]
Cranefly larvae															
Tipulidae	-	1	-	-	-	8	-	2	-	-	-	-	4	-	-
Phantom midge larvae															
Chaoborus	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-
Sewagefly larvae															
Psychodidae	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dancefly larvae															
Empididae	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Horsefly larvae															
Tabanidae	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-

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Table AI-17- Fishes Of The Cahaba River

Organism	Study 1	Study 2	Study 3
Petromyzontidae - lamprey family			
Ichthyomyzon gagei - southern brook lamprey	?		
Lampetra aepyptera - least brook lamprey	?		
Polyodontidae			
Polyodon spathula - paddle fish	?	x	
Lepisosteidae - gar family			
Lepisosteus oculatus - spotted gar	?		
Lepisosteus osseus - longnose gar	?	x	x
Amiidae - bowfin family			
Amia calva - bowfin	?		
Anguillidae - freshwater eel family			
Anguilla rostrata - American eel	?		
Clupeidae - herring family			
Alosa alabamae - Alabama shad	x		
Alosa chrysochloris - skipjack herring	?		
Dorosoma cepedianum - gizzard shad	x		x
Dorosoma petenense - threadfin shad	x		
Hiodontidae - mooneye family			
Hiodon tergisus - mooneye	?		
Esocidae - pike family			
Esox americanus - redfin pickerel	x		
Esox niger - chain pickerel	x		
Cyprinidae- minnow family			
Campostoma anomalum - stoneroller	x	x	x
Cyprinus carpio - carp	x	x	x
Ericymba buccata - silverjaw minnow	?	x	
Hybopsis aestivalis - speckled chub	x		
Hybopsis storeriana - silver chub	x		
Hybopsis winchelli - southern chub	?		
Nocomis leptocephalus - bluehead chub	x		
Notemigonus crysoleucas - golden shiner	x	x	x
Notropis aspetifrons - burrhead shiner	x	x	
Notropis baileyi - rough shiner	x		
Notropis atherinoides - emerald shiner		x	
Notropis bellus - pretty shiner	x	x	x
Notropis caeruleus - blue shiner	x	x	
Notropis callistius - Alabama shiner	x	x	x
Notropis chrosomus - rainbow shiner	x	x	
Notropis chrysocephalus - striped shiner	x	x	
Notropis stilbius - silverstripe shiner	x	x	
Notropis rexanus - weed shiner	x		
Notropis trichroistius - tricolor shiner	x	x	
Notropis uranoscopus - skygazing shiner	x		
Notropis venustus - blacktail shiner	x	x	

Table AI-17 - Fishes Of The Cahaba River (Cont'd)

Organism	Study 1	Study 2	Study 3
Notropis volucellus - mimic shiner	x	x	
Notropis xaenocephalus - Coosa shiner	x		
Notropis sp. - Cahaba shiner	x		
Opsopoeodus emiliae - pugnose minnow			
Phenacobius catostomus - riffle minnow	x	x	
Pimephales promeias - fathead minnow		x	
Semotilus atromaculatus - creek chub	x	x	x
Catostomidae - sucker family			
Carpiodes cyprinus - quillback	?		
Carpiodes veliter - highfin sucker	?		
Cycleptus elongatus - blue sucker	x		
Erimyzon oblongus - creek chub sucker	x	x	
Erimyzon tenuis - sharpfin sucker		x	
Hypentelium etawanum - Alabama hog sucker	x	x	x
Ictiobus bubalus - smallmouth buffalo	?		
Minytrema melanops - spotted sucker	x	x	
Moxostoma carinatum - river redhorse	?		
Moxostoma duquesnei - black redhorse	x	x	
Moxostoma erythrurum - golden redhorse	x	x	x
Moxostoma poedilurum - blacktail redhorse	x	x	
Ictaluridae - freshwater catfish family			
Ictalurus furcatus - blue catfish	?		
Ictalurus melas - black bullhead	?		
Ictalurus natalis - yellow bullhead	x	x	x
Ictalurus nebulosus - brown bullhead	?	x	
Ictalurus punctatus - channel catfish	x	x	x
Noturus funebris - black madtom	?		
Noturus gyrinus - tadpole madtom	?	x	x
Noturus leptacanthus - speckled madtom	x	x	
Noturus munitus - frecklebelly madtom	?		
Pylodictis olivaris-flathead catfish	x		
Cyprinodontidae - killifish family			
Fundulus olivaceus - black spotted topminnow	x	x	x
Fundulus stellifer - southern studfish	x		
Poeciliidae - livebearer family			
Gambusia affinis - mosquito fish	x	x	x
Atherinidae - silversides family			
Labidesthes sicculus - brook silversides			
Cottidae - sculpin family			
Cottus carolinae zopherus - Ala. banded sculpin	x	x	x
Centrarchidae - sunfish family			
Ambloplites rupestris - rockbass	x	x	
Centrarchus macropterus - flier		x	
Chaenbryttus guiosus - warmouth	x		
Elassoma zonatum - banded pigmy sunfish	?		
Lepomis cyanella - green sunfish	x	x	x
Lepomis macrochirus - bluegill	x	x	x
Lepomis marginatus - dollar sunfish		x	
Lepomis megalotis - longear sunfish	x	x	x

Table AI-17- Fishes Of The Cahaba River

Organism	Study 1	Study 2	Study 3
Lepomis microlophus - redear sunfish	x	x	x
Lepomis punctatus - spotted sunfish	x	x	x
Micropterus cocsae - redeye bass	x	x	x
Micropterus punctulatus - spotted bass	x	x	x
Micropterus salmoides - largemouth bass	x	x	x
Pomoxis annularis - white crappie	?	x	
Pomoxis nigromaculatus - black crappie	x	x	x
Percidae - perch family			
Etheostoma chlorosomum - bluntnose darter		x	
Etheostoma histri - harlequin darter	?		
Etheostoma jordani - greenbreast darter	x	x	
Etheostoma rupestri-rock darter	x	x	
Etheostoma stignaeum - speckled darter	x	x	
Etheostoma swaini - Gulf darter	x		
Etheostoma whippiei - redfin darter	x	x	x
Etheostoma sp.	x	x	x
Percina aurolineata - goldline darter	x		
Percina caprodes - log perch	x	x	x
Percina copelandi - channel darter	x		
Percina lenticula - freckled darter	?		
Percina maculata - blackside darter	x	x	
Percina nigrofasciata - blackbander darter	x	x	x
Percina shumardi - river darter	x	x	
Stizostedion vitreum - walleye	?		
Sciaenidae - drum family			
Aplodinotus grunniens - freshwater drum	x		

Study 1 - Checklist of fishes known from Cahaba River by John S. Ramsey, Alabama Cooperative Fisheries Research Unit. A question mark indicates the fish is probably found in the Cahaba River upstream from Helena, Alabama.

Study 2 - 201 Report - A list of species collected from Jefferson and Shelby County, Alabama.

Study 3 - September 1976 EPA Study.

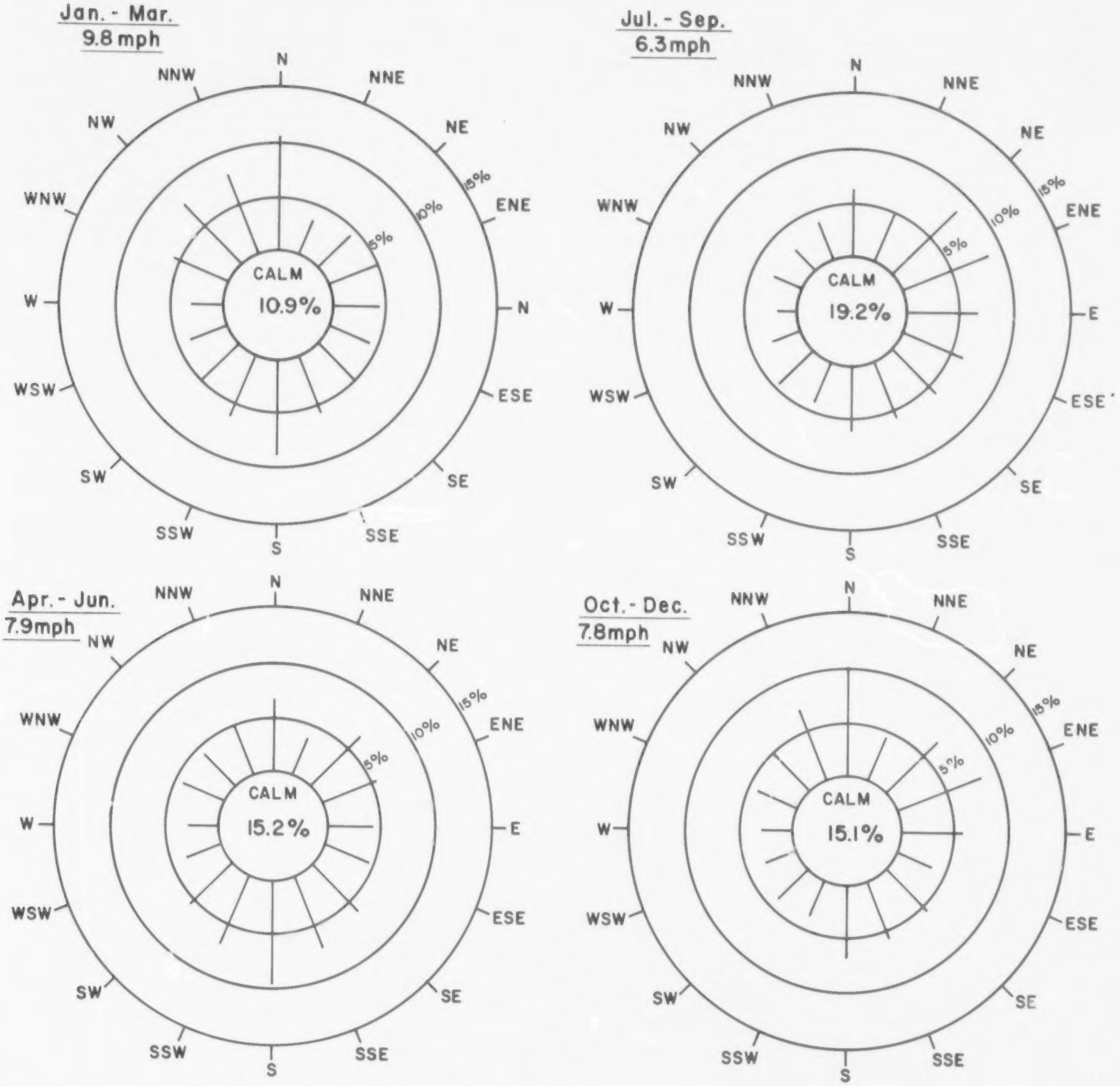
Table AI-18 - Summary Of Cahaba River Fish Kills

Date	Description
1965	Trussville, Alabama; 1750 suckers dead
1965	5475 fishes dead
1968	15,081 fishes dead
August 1970	Centreville, Alabama Discharge of pentachlorophenol (wood preservative) by W.E. Belcher Lumber Co. 7415 fish dead including largemouth bass, spotted bass, walleye, bream, buffalo, drum, channel, flathead and bullhead catfish, river red horse, spotted suckers and carp.
September 1970 1968	Mann Bros. Metalplating Co. had routine spills of cyanide into creek.
May 1965	Also 400 lb. container of calcium sulfate dumped into river, resulting pH = 10.0; 12,500 fishes dead including bass, beam and suckers.
1973	Ralston Purina Plant discharges in excess of 1 MGD. BOD removal 85%.
1973	Caustic soda spill resulted in six dead fish.

FIGURES

NATURAL ENVIRONMENT

AI-65-a



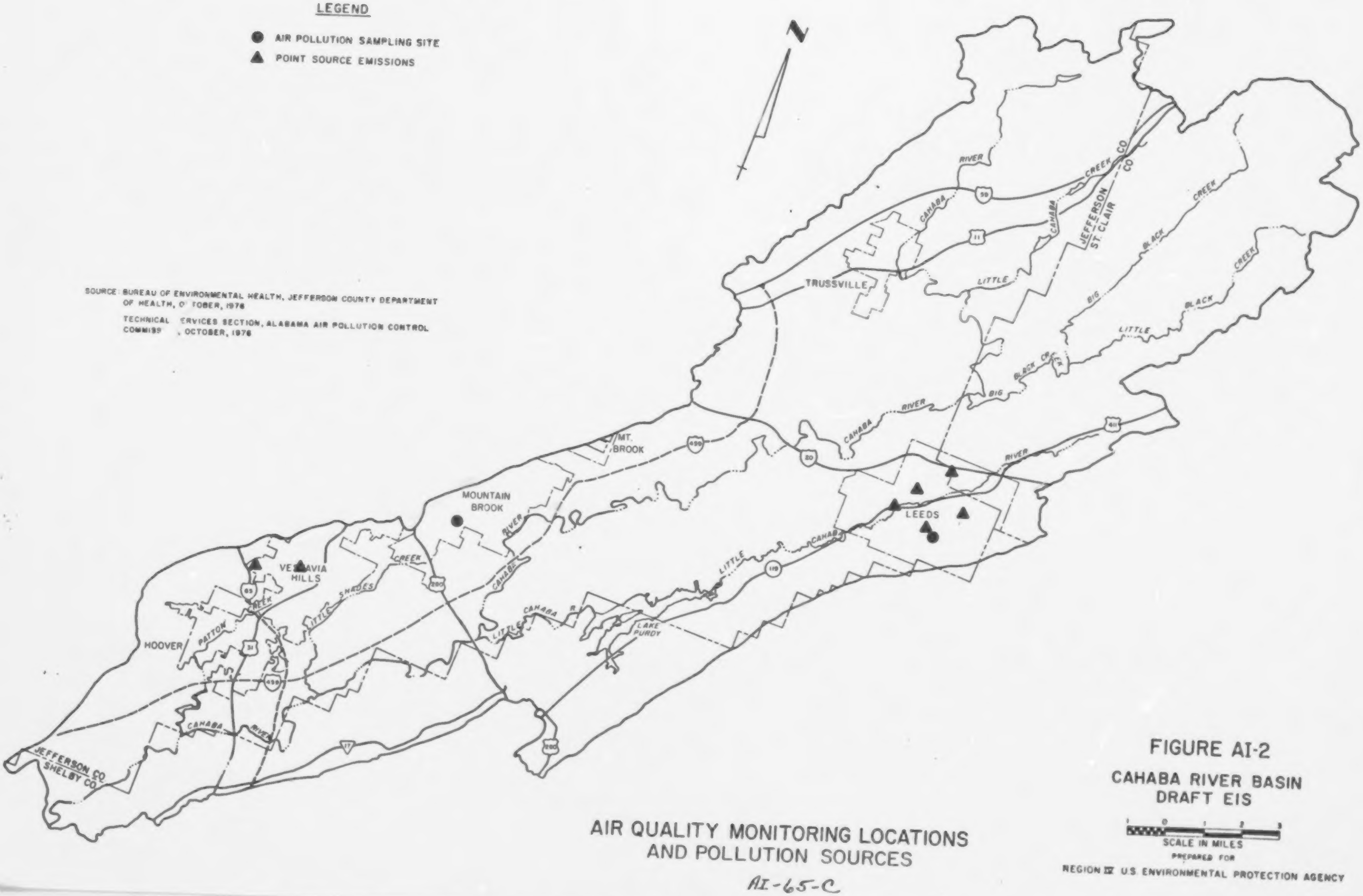
SOURCE: UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS, BIRMINGHAM, ALABAMA. MARCH 1953 - FEBRUARY 1963 NATIONAL CLIMATIC CENTER, ASHEVILLE, NORTH CAROLINA

FIGURE AI-1

CAHABA RIVER BASIN
DRAFT EIS
PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

SEASONAL WIND ROSES FOR
HE GREATER BIRMINGHAM AREA

AI-65-b



N
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JEFFERSON
ST. CLAIR
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CREEK
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LITTLE
BLACK CR
TRUSSVILLE
CAHABA
RIVER
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MT. BROOK
MOUNTAIN BROOK
LEEDS
VESTAVIA HILLS
SHADES
LITTLE
CREEK
PATTON
HOOVER
CAHABA R
LAKE PURDY
JEFFERSON CO
SHELBY CO

LEGEND

● AIR POLLUTION SAMPLING SITE

▲ POINT SOURCE EMISSIONS

SOURCE: BUREAU OF ENVIRONMENTAL HEALTH, JEFFERSON COUNTY DEPARTMENT OF HEALTH, OCTOBER, 1976

TECHNICAL SERVICES SECTION, ALABAMA AIR POLLUTION CONTROL COMMISSION, OCTOBER, 1976

AIR QUALITY MONITORING LOCATIONS
AND POLLUTION SOURCES

AI-65-C

FIGURE AI-2

CAHABA RIVER BASIN
DRAFT EIS

SCALE IN MILES

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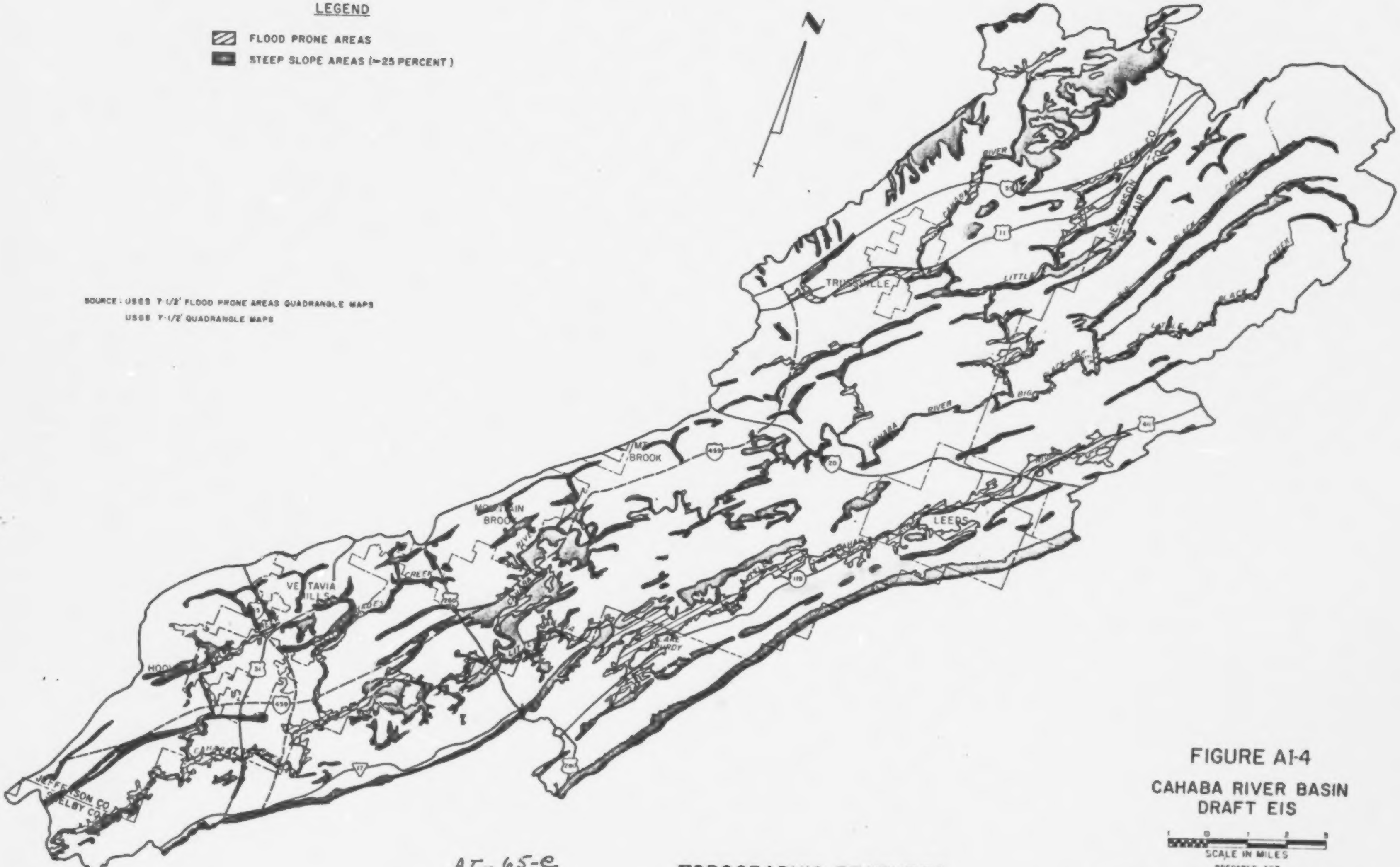
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

LEGEND

- ▨ FLOOD PRONE AREAS
- ■ STEEP SLOPE AREAS (>25 PERCENT)

SOURCE: USGS 7-1/2' FLOOD PRONE AREAS QUADRANGLE MAPS
USGS 7-1/2' QUADRANGLE MAPS


N
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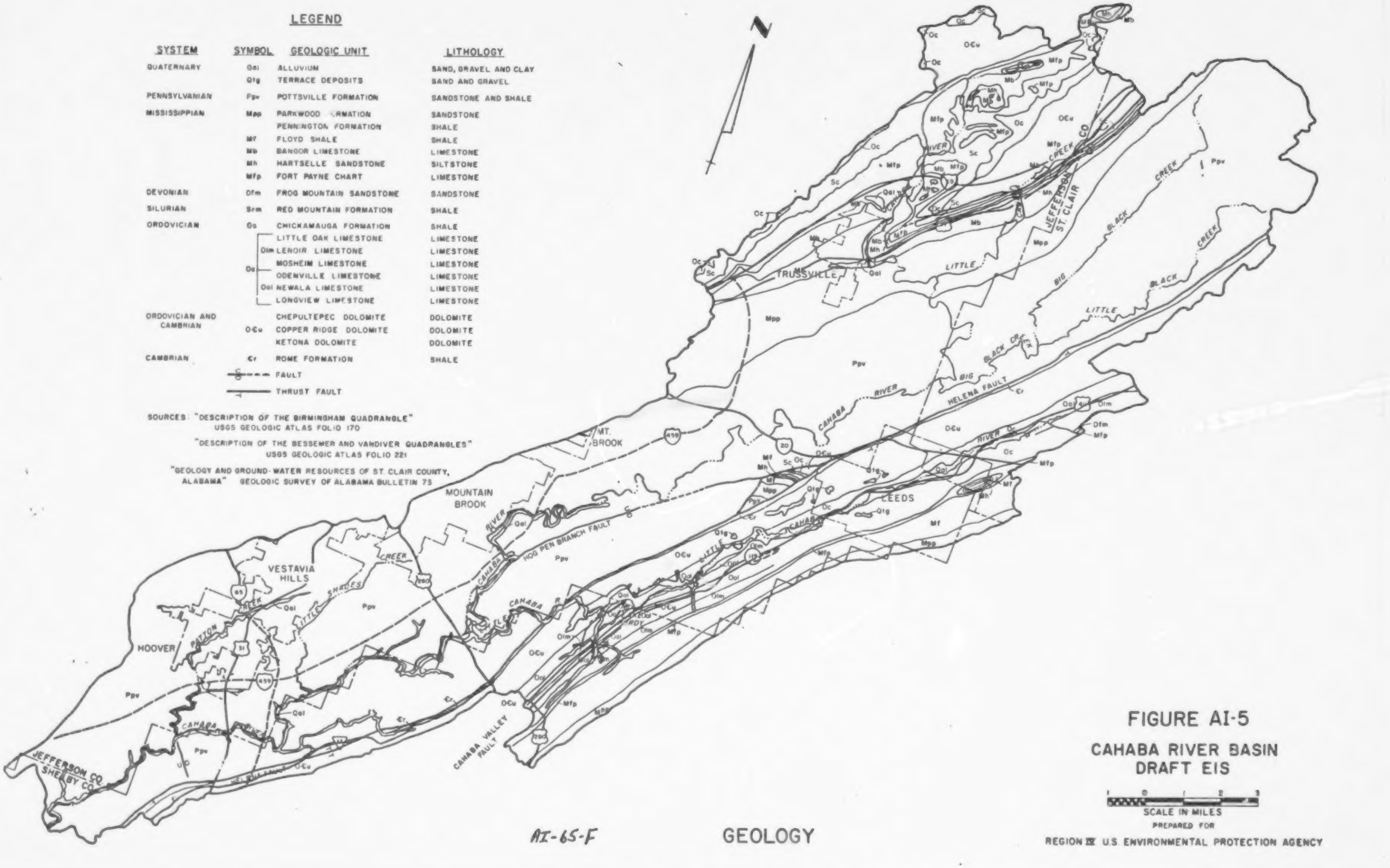
MT. BROOK
MOUNTAIN BROOK
LEEDS
VESTAVIA HILLS
CREEK
HOO
JEFFERSON CO
SHELBY CO

FIGURE AI-4
CAHABA RIVER BASIN
DRAFT EIS

1 0 1 2 3
SCALE IN MILES
PREPARED FOR
REGION IV US ENVIRONMENTAL PROTECTION AGENCY

TOPOGRAPHIC FEATURES

AI-65-e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MT. BROOK
MOUNTAIN BROOK
VESTAVIA HILLS
HOOVER
LEEDS
JEFFERSON CO
ST. CLAIR
JEFFERSON CO.
SHELBY CO.
CAHABA RIVER
LITTLE CAHABA
BIG BLACK CREEK
LITTLE BLACK CREEK
BIG BLACK CR.
LITTLE SHADES CREEK
PATTON CREEK
HOG PEN BRANCH FAULT
HELENA FAULT
CAHABA VALLEY FAULT
Ppv
Mpp
Mf
Mb
Mh
Mfp
Dfm
Sc
Oc
OЄu
Oal
Olm
Qtg
Qal
Єr
20
65
31
280
459

LEGEND

SYSTEM	SYMBOL	GEOLOGIC UNIT	LITHOLOGY
QUATERNARY	Qal	ALLUVIUM	SAND, GRAVEL AND CLAY
	Qtg	TERRACE DEPOSITS	SAND AND GRAVEL
PENNSYLVANIAN	Ppv	POTTSVILLE FORMATION	SANDSTONE AND SHALE
MISSISSIPPIAN	Mpp	PARKWOOD FORMATION	SANDSTONE
		PENNINGTON FORMATION	SHALE
	Mf	FLOYD SHALE	SHALE
	Mb	BANGOR LIMESTONE	LIMESTONE
	Mh	HARTSELLE SANDSTONE	SILTSTONE
	Mfp	FORT PAYNE CHART	LIMESTONE
DEVONIAN	Dfm	FROG MOUNTAIN SANDSTONE	SANDSTONE
SILURIAN	Srm	RED MOUNTAIN FORMATION	SHALE
ORDOVICIAN	Oc	CHICKAMAUGA FORMATION	SHALE
	Ok	LITTLE OAK LIMESTONE	LIMESTONE
	Ok Olm	LENOIR LIMESTONE	LIMESTONE
	Ok	MOSHEIM LIMESTONE	LIMESTONE
	Ok	ODENVILLE LIMESTONE	LIMESTONE
	Ok Oal	NEWALA LIMESTONE	LIMESTONE
	Ok	LONGVIEW LIMESTONE	LIMESTONE
ORDOVICIAN AND CAMBRIAN	OЄu	CHEPULTEPEC DOLOMITE	DOLOMITE
	OЄu	COPPER RIDGE DOLOMITE	DOLOMITE
	OЄu	KETONA DOLOMITE	DOLOMITE
CAMBRIAN	Єr	ROME FORMATION	SHALE
		FAULT	
		THRUST FAULT	

SOURCES: "DESCRIPTION OF THE BIRMINGHAM QUADRANGLE"
USGS GEOLOGIC ATLAS FOLIO 170

"DESCRIPTION OF THE BESSEMER AND VANDIVER QUADRANGLES"
USGS GEOLOGIC ATLAS FOLIO 221

"GEOLOGY AND GROUND-WATER RESOURCES OF ST. CLAIR COUNTY, ALABAMA" GEOLOGIC SURVEY OF ALABAMA BULLETIN 73

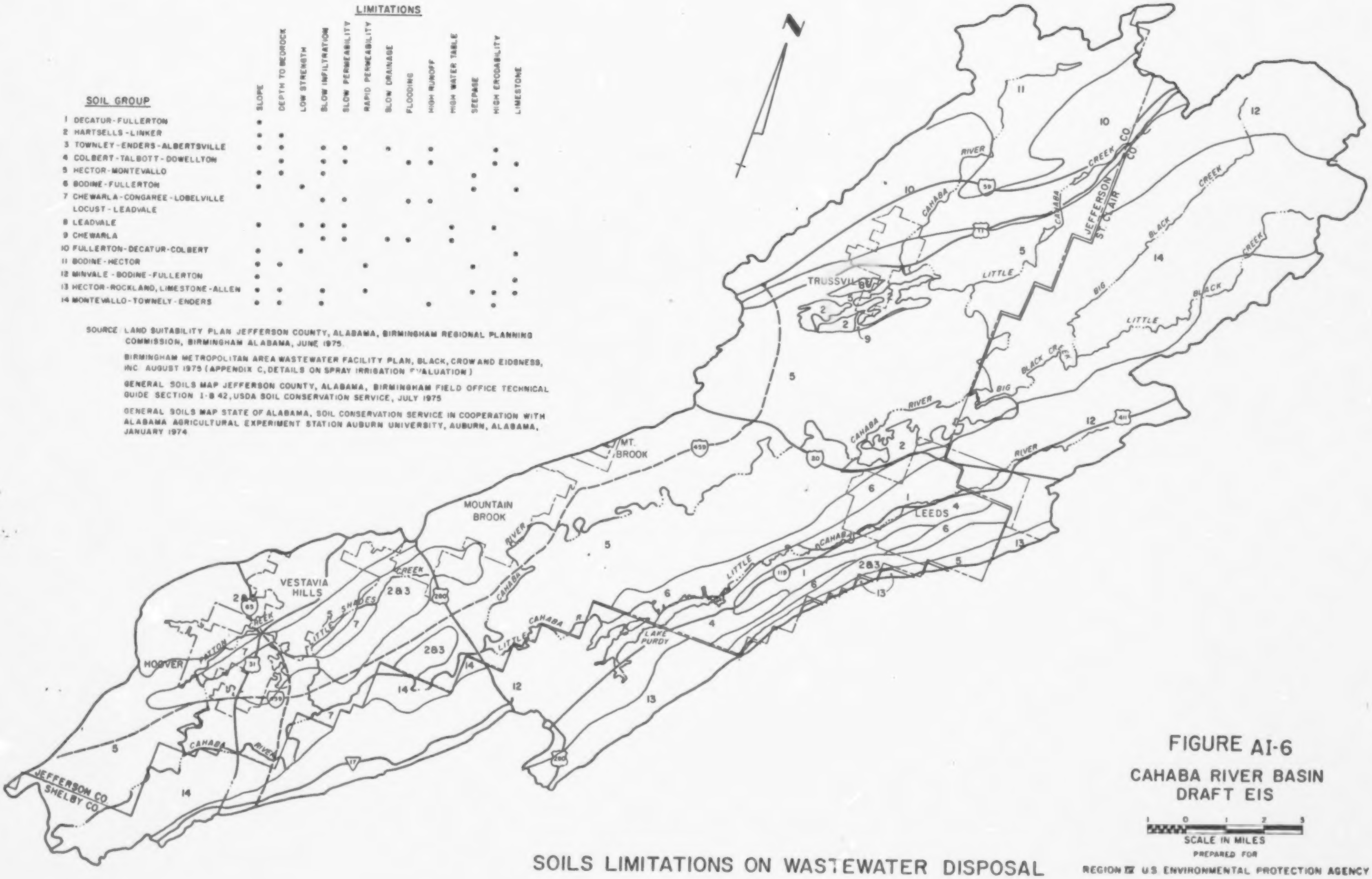
FIGURE AI-5
CAHABA RIVER BASIN
DRAFT EIS

0 1 2 3
SCALE IN MILES

PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

AI-65-F

GEOLOGY


N
TRUSSVILLE
MT. BROOK
MOUNTAIN BROOK
VESTAVIA HILLS
HOOVER
LEEDS
LAKE PURDY
CAHABA RIVER
LITTLE CAHABA R
CAHABA CREEK
BIG BLACK CREEK
LITTLE BLACK CREEK
SHADES CREEK
LITTLE SHADES CREEK
PATTON CREEK
JEFFERSON CO
ST. CLAIR CO
JEFFERSON CO
SHELBY CO
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12
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14
283
0
1
2
3
SCALE IN MILES

SOIL GROUP	SLOPE	DEPTH TO BEDROCK	LOW STRENGTH	SLOW INFILTRATION	SLOW PERMEABILITY	RAPID PERMEABILITY	SLOW DRAINAGE	FLOODING	HIGH RUNOFF	HIGH WATER TABLE	SEEPAGE	HIGH ERODABILITY	LIMESTONE
1 DECATUR-FULLERTON	●												
2 HARTSELLS-LINKER	●	●											
3 TOWNLEY-ENDERS-ALBERTSVILLE	●	●		●	●		●		●			●	
4 COLBERT-TALBOTT-DOWELLTON		●		●	●			●	●			●	●
5 HECTOR-MONTEVALLO	●	●		●							●		
6 BODINE-FULLERTON	●		●								●		●
7 CHEWARLA-CONGAREE-LOBELVILLE LOCUST-LEADVALE				●	●			●	●				
8 LEADVALE	●		●	●	●					●		●	
9 CHEWARLA				●	●		●	●		●			
10 FULLERTON-DECATUR-COLBERT	●		●										●
11 BODINE-HECTOR	●	●				●					●		
12 MINVALE-BODINE-FULLERTON	●												●
13 HECTOR-ROCKLAND, LIMESTONE-ALLEN	●	●		●		●					●	●	●
14 MONTEVALLO-TOWNELY-ENDERS	●	●		●					●			●	

SOURCE: LAND SUITABILITY PLAN JEFFERSON COUNTY, ALABAMA, BIRMINGHAM REGIONAL PLANNING COMMISSION, BIRMINGHAM ALABAMA, JUNE 1975.

BIRMINGHAM METROPOLITAN AREA WASTEWATER FACILITY PLAN, BLACK, CROW AND EIDSNESS, INC AUGUST 1975 (APPENDIX C, DETAILS ON SPRAY IRRIGATION EVALUATION)

GENERAL SOILS MAP JEFFERSON COUNTY, ALABAMA, BIRMINGHAM FIELD OFFICE TECHNICAL GUIDE SECTION I-B 42, USDA SOIL CONSERVATION SERVICE, JULY 1975

GENERAL SOILS MAP STATE OF ALABAMA, SOIL CONSERVATION SERVICE IN COOPERATION WITH ALABAMA AGRICULTURAL EXPERIMENT STATION AUBURN UNIVERSITY, AUBURN, ALABAMA, JANUARY 1974

SOILS LIMITATIONS ON WASTEWATER DISPOSAL

FIGURE AI-6

CAHABA RIVER BASIN
DRAFT EIS

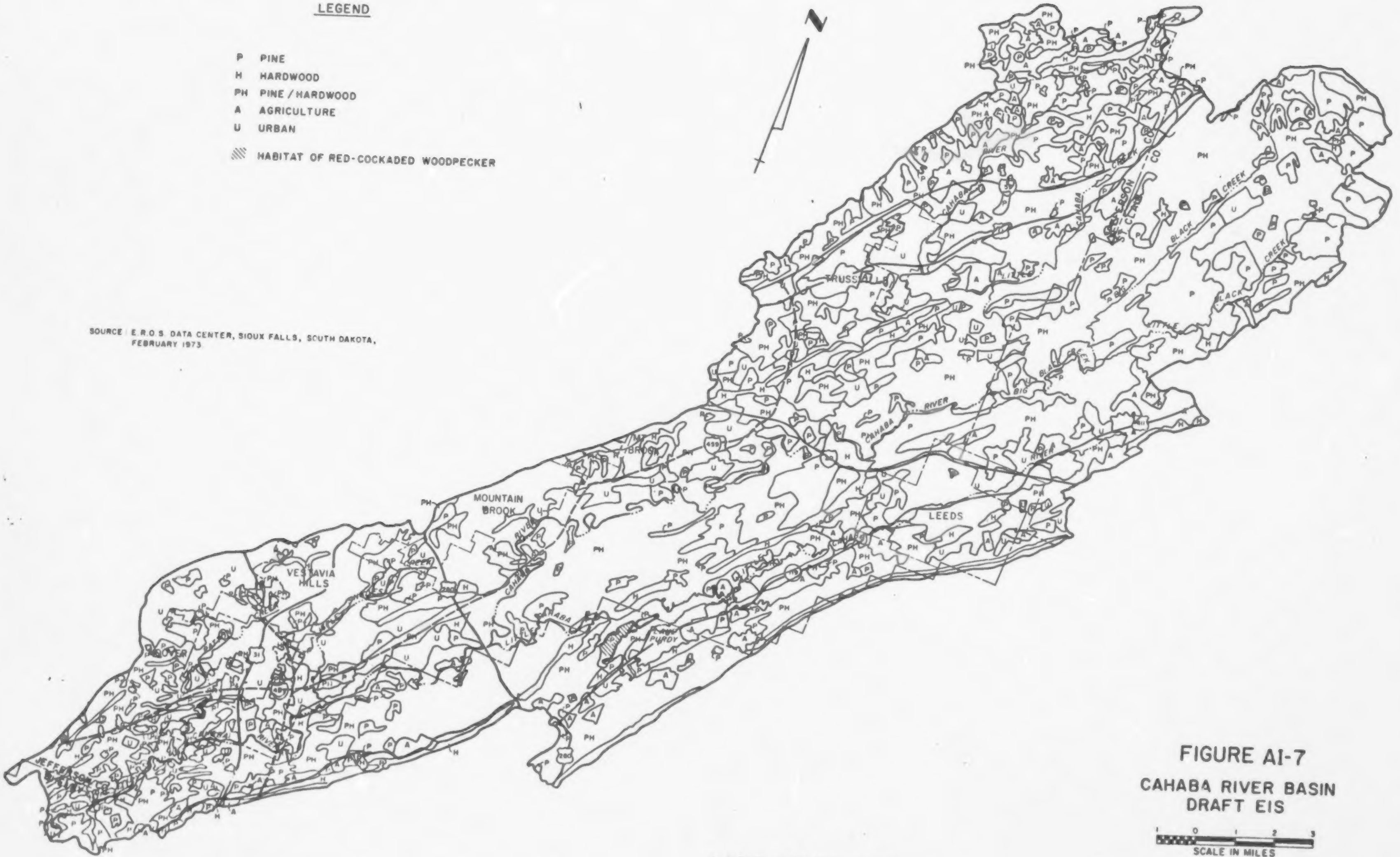
PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

LEGEND

P PINE
H HARDWOOD
PH PINE / HARDWOOD
A AGRICULTURE
U URBAN

▨ HABITAT OF RED-COCKADED WOODPECKER

SOURCE: E.R.O.S. DATA CENTER, SIOUX FALLS, SOUTH DAKOTA, FEBRUARY 1973


N
TRUSSVILLE
MOUNTAIN BROOK
VESTAVIA HILLS
LEEDS
CAHABA RIVER
BLACK CREEK
LITTLE CAHABA
JEFFERSON
PH
P
H
A
U

LAND COVER MAP

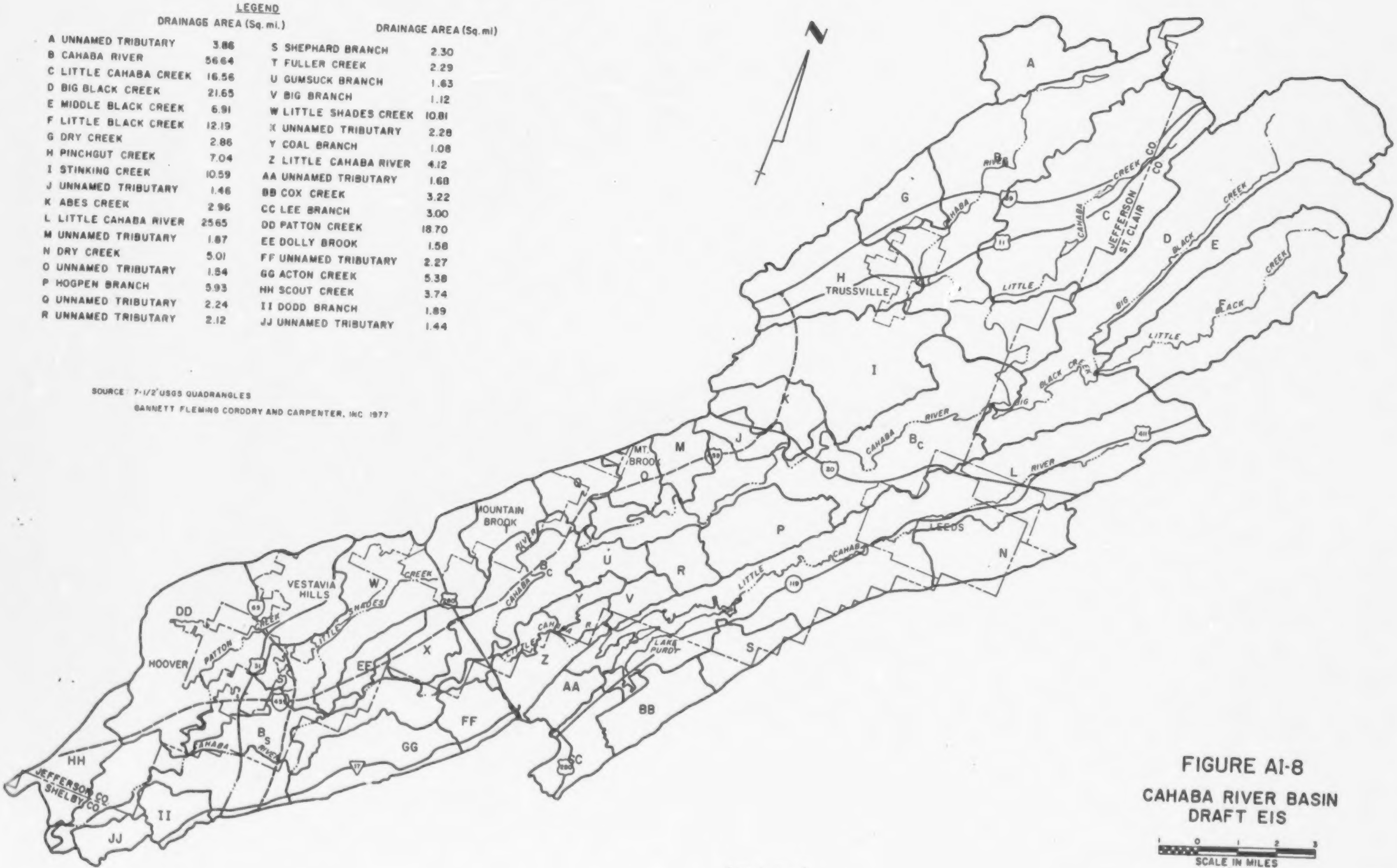
AI-65-h

FIGURE AI-7

CAHABA RIVER BASIN
DRAFT EIS

1 0 1 2 3
SCALE IN MILES

PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY



A
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G
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JEFFERSON CO
ST. CLAIR CO
CAHABA
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LEEDS
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MOUNTAIN BROOK
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CAHABA RIVER
LITTLE CAHABA
VESTAVIA HILLS
W
CREEK
SHADES
LITTLE
DD
PATTON CREEK
HOOVER
X
EE
Y
V
CAHABA R
LITTLE
Z
LAKE PURDY
S
AA
BB
FF
GG
CC
B S
CAHABA RIVER
HH
JEFFERSON CO
SHELBY CO
II
JJ

LEGEND

	DRAINAGE AREA (Sq. mi.)		DRAINAGE AREA (Sq. mi)
A UNNAMED TRIBUTARY	3.86	S SHEPHARD BRANCH	2.30
B CAHABA RIVER	56.64	T FULLER CREEK	2.29
C LITTLE CAHABA CREEK	16.56	U GUMSUCK BRANCH	1.63
D BIG BLACK CREEK	21.65	V BIG BRANCH	1.12
E MIDDLE BLACK CREEK	6.91	W LITTLE SHADES CREEK	10.81
F LITTLE BLACK CREEK	12.19	X UNNAMED TRIBUTARY	2.28
G DRY CREEK	2.86	Y COAL BRANCH	1.08
H PINCHGUT CREEK	7.04	Z LITTLE CAHABA RIVER	4.12
I STINKING CREEK	10.59	AA UNNAMED TRIBUTARY	1.68
J UNNAMED TRIBUTARY	1.46	BB COX CREEK	3.22
K ABES CREEK	2.96	CC LEE BRANCH	3.00
L LITTLE CAHABA RIVER	25.65	DD PATTON CREEK	18.70
M UNNAMED TRIBUTARY	1.87	EE DOLLY BROOK	1.58
N DRY CREEK	5.01	FF UNNAMED TRIBUTARY	2.27
O UNNAMED TRIBUTARY	1.54	GG ACTON CREEK	5.38
P HOGPEN BRANCH	5.93	HH SCOUT CREEK	3.74
Q UNNAMED TRIBUTARY	2.24	II DODD BRANCH	1.89
R UNNAMED TRIBUTARY	2.12	JJ UNNAMED TRIBUTARY	1.44

SOURCE: 7-1/2' USGS QUADRANGLES

GANNETT FLEMING CORDDRY AND CARPENTER, INC 1977

FIGURE AI-8

CAHABA RIVER BASIN
DRAFT EIS

1 0 1 2 3
SCALE IN MILES

PREPARED FOR

REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

AI-65-i

POPULATION AND LAND USE CHARACTERISTICS

A description of existing and future population and land use characteristics is contained within Chapter II, Part B of the Environmental Impact Statement. This includes an allocation by subwatershed of existing and projected basin populations and also the description of future land use characteristics for the basin. Existing and future population densities and land use characteristics have been mapped and are presented in Figures II-1, 2, 3 and 4 of Chapter II.

Detailed methodologies for population allocation and land use forecasting were previously prepared and transmitted to EPA, Region IV. The following is a summary of the methodologies utilized to develop population allocations for subwatersheds and land use forecasting in the Cahaba River Basin.

Methodology for Unconstrained Population Forecasts and Subwatershed Allocations

The method by which the unconstrained population projections for the Cahaba Basin Study Region have been produced entails three major steps. First, select an accepted and plausible set of county-level projections. Second, convert these into census tract estimates for all tracts overlapping the Study Region. Third, convert these census tract estimates into subwatershed populations within the Study Region.

Step 1. The county-level projections utilized in this study are those produced by the Battelle Memorial Institute's Columbus Laboratories for the Birmingham Regional Planning Commission.[1] These projections are linked to an economic base analysis of the six-county BRPC region (Blount, Chilton, Jefferson, Shelby, St. Clair and Walker Counties), designed to provide employment forecasts in five-year intervals to the year 2000. Subsequently, following further analysis comparing these forecasts to others for the region, the BRPC determined to elevate the Battelle projections by 4.7%. These modified Battelle projections are currently accepted as the official projections for the BRPC six-county region.

The Battelle forecasting model, known as DEMOS (Demographic-Economic Modeling System), generates forecast beginning with the 1970 census enumerations. Four distinct sub-models compose the modeling system corresponding to these sectors of activity: demographic, economic, housing, and income. The demographic model simulates growth in population according to the major components of change: natural increase (i.e. births less deaths), and net migration. Uniform death (mortality) rates are assumed throughout the region while birth rates are determined by county and adjusted according to U.S. Census Bureau national projections of fertility trends. These trends, established in the Series E Census forecasts approach 2.11 births per woman (during her lifetime) by the year 2000. Marginal adjustments in fertility trends are produced through economic and demographic interactions within the model system. Migration rates are established for twelve age cohorts and adjusted according to economic conditions within the region as a whole. Four distinct projection series were produced in this manner, each using a different combination of exogenous parameters. The first is the "baseline" series, considered by Battelle to be its best estimate because of the strength of its underlying assumptions. Three alternate scenarios were also produced. Scenario One assumes "Low U.S. Growth", while Scenario Two assumes "Southern Growth" rates, and Scenario Three assumes "High U.S. Growth" rates. In each instance the Birmingham region was assumed to follow the respective regional or national trend. Ultimately the BRPC elected to adopt the second scenario, "Southern Growth" rates. It is these which are finally elevated by 4.7% to reflect the somewhat more optimistic projections of the OBERS series.[2]

---

[1] Battelle Memorial Institute, Columbus Laboratories, Economic Base Analysis of the Birmingham Six-County Planning Area (Columbis, Ohio: Battelle, Columbus Laboratories, 1976), in several volumes: The study methodology is summarized in Vol. IV, "Technical Appendix for Major Modeling Programs."

Step 2. Next, the modified Battelle (Scenario Two) projections were allocated to census tracts by the BRPC, as follows:

A). Conduct independent housing unit forecasts in five year intervals by census tract using a regression model whose dependent variable was the increase in total dwelling units by tract during the period 1960-75. The model's explanatory variable included various objective characteristics of each tract. Resulting projections by tract were subsequently further constrained according to space (vacant land) capacity and maximum residential densities established by local ordinances and plans.

B). Adjust housing unit forecasts by tract to insure consistency with county control totals established in step 1. This required the conversion of housing to population tabulations assuming constant family size and vacancy rates except where the Battelle projections indicated a contrary trend. When the summation of tract populations within single counties was more than that specified in step 1, all tract estimates were proportionately reduced. Alternately, if the tract summation was less than the county control total estimated in step 1, all tracts were proportionally increased though tract capacities were never exceeded.

[2] The OBERS projections are produced by a joint effort of the U.S. Departments of Commerce and Agriculture for the U.S. Water Resources Council for economic regions, states, water resource areas and SMSA's. Two separate national series exist. The first utilizes the U.S. Census Bureau's Series C (higher birth rates) national projections, while the second assumes the lower rates of the Series E national projections. In addition OBERS assisted in the production of county-level projections for all counties in the EPA's Region IV.

Step 3. In the third and final step, census tract projections are converted into projections by subwatershed within the Cahaba Basin. To accomplish this task, the Environmental Assessment Council, Inc. has created and calibrated a "spatial" allocation model called "LANDEV".

In overview, the model, LANDEV, allocates the exogenous population forecasts provided by the BRPC for each of the 16 census tracts to each subwatershed at five year time intervals. Since the boundaries of census tracts are not coterminous with those of subwatersheds the entire Study Region was divided into one-mile square zones, based on the township and range grid system, to aid in the compilation and updating of base data. Many of these zones were subsequently divided geographically among census tracts and subwatersheds to facilitate the allocation procedure.

The heart of the model is a numerical relationship which evaluates each zones in each census tract according to its developmental "attractiveness". Zonal attractiveness scores are subsequently used to apportion census tract projections among interior zones. The procedure precludes development on floodplains and steeply sloped terrain. Per capita net residential space consumption rates defined by census tracts according to prior development intensities are applied to zonal population allocations to determine the amount of space consumed per zone per interval of time (five years). Zonal residential space capacities equal all space (one-mile square maximum) less undevelopable land, land already in residential and non-residential (no-extractive, non-farm) use, and some portion of currently vacant land designated for future non-residential use (according to rates specific to census tracts). When zonal residential space capacities are exceeded, the excess allocation of population (residential development) is diverted to other zones having surplus space within the census tract, according to attractiveness scores. Zonal space and land use accounts are continuously updated and wholly consistent. After each five year increment, zonal totals are tabulated by subwatershed.

Land Use Forecasting Methodology

The forecasting of population and land use are closely connected. Population translates into households which occupy residential space. How much and what kind of residential space is preferred by households and supplied by the area's developers will determine the pattern of residential land use. Most land within the Cahaba Basin Study Region is currently vacant. Within the more developed places, however, the majority of land is in active residential use.

The basis for the unconstrained land use forecasts are the unconstrained population projections previously described. These population projections for the Cahaba Basin Study Region are derived from the Battelle Memorial Institute's county-level projections commissioned by the Birmingham Regional Planning Commission and published in 1974. The specific Battelle projection series relied upon is that which assumes the Birmingham six-county region economy will evolve commensurate with overall growth within the southern states for the foreseeable future. These projections were subsequently modified (+4.7%) to reflect the higher growth rates foreseen in an independent assessment of regional growth.

The BRPC later allocated these forecasts to census tracts using an allocation model calibrated to prior development forces within the region. Subsequently, the Environmental Assessment Council, Inc. applied its model, "LANDEV" to allocate tract forecasts to subwatersheds within the Cahaba Basin Study Region. This model allocated amounts of tract populations to subwatersheds according to their relative developmental attractiveness subject to the availability of sufficient undeveloped land. The determinants of residential attractiveness utilized by LANDEV included both accessibility (to points of employment and prior development) and site factors such as slope, elevation and soil conditions. This model was calibrated to previous development within the region and therefore its resulting forecast constitutes a baseline unconstrained by the availability of wastewater treatment facilities. These subwatershed forecasts were converted into a regional land use map for the year 2000.

In order to produce the land use map, aggregate zonal population allocations produced by "LANDEV" were converted to quantities of residential space and then assigned to sites within individual zones according to these rules:

1. No residential development would be assigned to lands which floods or is steeply sloped.
2. No residential development would be assigned to lands on which alternate activities are already programmed.
3. Regarding developable land not eliminated by either of these first two criteria, the following general assignment principles apply:
    i. Where no overriding constraints apply, development will tend to be contiguous.
    ii. Programmed development will tend to have sequential priority.
    iii. Assignments will reflect developer "propensities" and household "preferences" to the extent that these can be imputed to the statistical characteristics of the population projections.

Assignments on non-residential development in the several categories indicated on the land use map are based upon the following general principles:

1. All current and most already programmed developments are included.
2. Additional future development (particularly industrial and commercial) about which there exists an emerging consensus among representatives of the Study Region are also included.
3. Those current facilities which are capable of on-site or adjacent-site expansion to meet future demands are acknowledged.

4. Most additional development not covered by these first three situations is not documented on the map except when there is compelling evidence that this development will be likely to occur.

The task of projecting a spatially "extensive" land use such as residential is far from easy, yet there do exist certain modelling procedures which will produce plausible projections when large numbers of individual locational decisions (of developers and households) are involved and when the zonal repositories of these projections are not excessively small. Fortunately, these necessary conditions existed in the Cahaba Basin. The application of LANDEV, consequently, provides zonal and subwatersheds projections having reasonable tolerances.

The assignment of aggregate zonal population projections to specific sites within zones is less easily accomplished since the number of locational decisions which will be made are often both diverse and non-uniformly weighted. Consequently few if any models can be reliably calibrated to this analytic scale. The assignment procedure is therefore necessarily subjective, but consistent with previously stated assignment rules.

EMPLOYMENT CHARACTERISTICS

Table AI-20 present employment characteristics for the three counties which are located within the Cahaba River EIS study area. Jefferson County is the most significant with a 1970 total employment of 232,844. County employment trends for 1970 indicate that services are the largest single employer (65,829) in the county. Manufacturing is the second largest employer in the county. However, during the decade from 1960 to 1970, there was a net loss of 1,952 jobs in manufacturing. Most of these losses caused by significant employment reductions in the iron and steel industry in Jefferson County. Wholesale and retail trade has also shown significant increases from 44,299 jobs in 1960 to 53,348 in 1970. Government employment increase were relatively small and ranked well behind national increases in government employment.

Shelby County had a 1970 employment total of only 13,324. Manufacturing is the largest employment category in the county with a 1970 level of 4,084. This represents an increase over 1960 levels (3,154), but the percentage of total employment in manufacturing decreased from 32.3 percent in 1960 to 30.7 percent in 1970. Services are the county's second largest employer followed closely by wholesale and retail trade.

St. Clair County is the smallest of the three study area counties in total employment with a 1970 level of 9,150. Manufacturing is by far the largest employer with a total of 3,281 in 1970. This accounted for 35.9 percent of all employment in the county. Once again services and wholesale and retail trade followed in second and third places. An interesting employment figure in St. Clair County is the significant decline in agricultural employment during the decade from 1960 to 1970. During this period, employment fell from 686 jobs in 1960 to 320 in 1970. This represents a drop in the county's percent of total employment from 8.9 percent in 1960 to 3.4 percent in 1970.

Table AI-21 provides another profile of employment characteristics in the study area. This table reviews employment in the various municipalities in the study area. Birmingham, which is not actually located in the study area but yields significant influence on the Cahaba River, has the greatest total employment of any of the municipalities with a 1970 employment level of 114,725. Much of this employment is in either manufacturing (21.6 percent) or wholesale and retail trade (23.1 percent). Only 10.5 percent of Birmingham's employment is in the services category. Much of the services employment is located in suburban communities. This is substantiated by a review of the employment data for suburban communities such as Vestavia Hills, Homewood and Mountain Brook. In each of these communities services account for nearly 25 percent of the employment total. Trade is also a major employer in these suburban communities. This is supported by the growth of large shopping centers and other retail outlets in the suburban areas. Manufacturing is not significant in any of these three suburban communities. Employment data for Leeds indicates the significance of manufacturing employment in that community. In 1970, 43.8 percent of the total employment for Leeds was in manufacturing. Trade and services were well behind as significant employers.

Income

Total personal income, per capita income and median family income are good indicators of the economic health of a region. Aggregate personal income, per capita income and median family income for the United States, Alabama, the BRPC Region and each of the counties in the study area is presented in Table AI-22.

The table indicates that per capita income in the region and each of the counties is below the national level of per capita income. The BRPC Region's per capita income of $2,651 is higher than Alabama's per capita income of $2,317. Jefferson County has the region's highest per capita income of $2,821. Although per capita income for the region is below national levels, trends from 1960-1970 indicate that the region is experiencing an average annual growth rate of 5.7 percent, which is ahead of the nation's average annual rate of 5.4 percent.

Each of the three counties which are within the study area have a per capita income below the national level. However, each of the counties have an average annual growth rate that exceeds the national average of 5.4 percent. This would seem to indicate that the counties in the study area are closing the gap on the per capita income differential. In 1970 Jefferson County had the highest per capita income in the study area. However, its average annual growth rate from 1960 to 1970 was the lowest of the three counties in the study area.

Similar trends are also evident in median family income. Each of the three counties in the study area have a 1970 median income that is below the national average. Shelby and St. Clair County each have average annual growth rates considerably above the national average growth rate.

Table AI-23 presents income data for the various municipalities within the study area. A review of the data quickly indicates the relative affluence of the communities of Vestavia Hills, Homewood and Mountain Brook. Each of the communities have median family income that is well above national averages. Other communities such as Irondale, Leeds and Birmingham exhibit income characteristics that are more indicative of income trends in the region.

Establishments in the Region and Study Area

Table AI-26 presents the number of establishments by employment category which are located in the state of Alabama, the BRPC Region and the three counties in the study area.

The table indicates that in 1973 there were 12,819 establishments in the BRPC Region, of which 2,107 had greater than 20 employees. Wholesale and retail trade accounted for 37 percent of the establishments and services accounted for 29 percent of the total establishments. Manufacturing establishments were only eight percent of the region's total, but nearly 50 percent of these establishments had greater than 20 employees.

A review of the individual counties indicates that 10,463 establishments are located in Jefferson County. This is 82 percent of all establishments in the region. Wholesale and retail trade had the highest number of establishments in the county (3,797) followed by services (3,205) and finance, insurance and real estate (1,116). Shelby County had the next highest number of establishments (545) followed by St. Clair County (327).

WATER SUPPLY STUDY*

Alternative A1 - Develop Coosa River and Maintain Lake Purdy - Under this alternative the Cahaba River would be replaced by developing a new source of supply from the Coosa River. Raw water would be pumped from Logan Martin Lake on the Coosa River to the Little Cahaba River. In addition a new intake facility and pipeline would be constructed to convey raw water from Lake Purdy to the Cahaba Pumping Station.

Alternative A2 - Develop Mulberry Fork and Maintain Lake Purdy - This alternative would replace the supply from the Cahaba River by developing a new source of supply from the Mulberry Fork of the Black Warrior River. Water would be pumped from Mulberry Branch to the Shades Mountain Filter Plant. The construction of a booster pumping station would probably be required in the vicinity of the Western Filter Plant. A new intake facility and pipeline would be constructed to convey raw water from Lake Purdy to the Cahaba Pumping Station.

Alternative A3 - Develop Locust Fork Near Partridge Crossroads and Maintain Lake Purdy - This alternative would replace the Cahaba River by developing a new source of supply from the Locust Fork of the Black Warrior River near Partridge Crossroads. A dam would be constructed on Locust Fork with a reservoir being created for use in water supply and low flow augmentation. Raw water would be conveyed to the Shades Mountain Filter Plant for treatment and distribution. In addition, a new intake facility and pipeline would be constructed to convey raw water from Lake Purdy to the Cahaba Pumping Station.

Alternative A4 - Develop Locust Fork at Smith's Ford and Maintain Lake Purdy - Replace the supply from the Cahaba River by developing a new source of supply from the Locust Fork north of the Black Warrior River. A dam would be constructed at Smith's Ford and the resulting reservoir would be used for low flow augmentation and for water supply. Raw water would be conveyed to the Shades Mountain Filter Plant for treatment and distribution. A new intake facility and pipeline would be constructed to convey raw water from Lake Purdy to the Cahaba Pumping Station.

Alternative A5 - Develop Big Black Creek and Maintain Lake Purdy - This alternative would replace the Cahaba River by developing a new source of supply from Big Black Creek. The proposed dam and reservoir would be utilized for low flow augmentation as well as water supply. A new intake facility and pipeline would be constructed to convey raw water from Lake Purdy to the Cahaba Pumping Station.

*Source: Water Supply Study for the Water Works Board of the City of Birmingham. Malcolm Pirnie, Inc., April 1977.

Alternative B1 - Develop Coosa River - Under this alternative the Water Works Board would replace the entire Cahaba River system with a new source of water supply from the Coosa River. Raw water would be pumped directly from Logan Martin Lake on the Coosa River to the Cahaba Pumping Station. Raw water would be treated at the Shades Mountain Filter Plant. Since Lake Purdy would no longer be in use, the capacity of the facilities in this alternative would be larger than in Alternative A1.

Alternative B2 - Develop Mulberry Fork - Replace the Cahaba River System with a new source of supply from the Mulberry Fork of the Black Warrior River. Raw water would be pumped to the Shades Creek Filter Plant for treatment and distribution. The Cahaba Pumping Station could also be abandoned. Facilities required to develop this supply would be similar to those of Alternative A2, but would have larger capacities.

Alternative B3 - Develop Locust Fork near Partridge Crossroads - This alternative would replace the entire Cahaba River system with construction of a dam and reservoir on Locust Fork of the Black Warrior River. Raw water would be pumped directly to the Shades Mountain Filter Plant for treatment and distribution. The Cahaba Pumping Station could be abandoned. The facilities required to develop this supply would be similar to those of Alternative A3 but would have larger capacities.

Alternative B4 - Develop Locust Fork at Smith's Fork - Under this alternative the entire Cahaba River System would be replaced by a new source of supply from the Locust Fork of the Black Warrior River. This alternative would involve the construction of a dam and reservoir on Locust Fork. Raw water would be pumped directly to the Shades Mountain Filter Plant for treatment and distribution. The Cahaba Pumping Station could be abandoned, but consideration should be given to a limited maintenance program that would allow the Board to utilize the Cahaba River water supply during extreme emergencies. The facilities required to develop this new supply would be similar to those of Alternative A4, but would have larger capacities.

Alternative C1 - Raise the Level of Lake Purdy by Ten Feet - This alternative is currently under active consideration by the Water Works Board and the Jefferson County Commissioners. Under this proposal, the level of Lake Purdy would be raised by an additional ten feet. The intent would be for flow augmentation only, but would also provide additional flows on the Cahaba River for water supply purposes. This alternative would cost approximately $7 million including dam construction, clearing of land and roadway relocation.

COMMUNITY SERVICES AND FACILITIES

Shelby County

Police Protection. The Sheriff's Department maintains a jail and courthouse at the county seat. A new jail is under construction. Together the jail and courthouse employ about 20 people.

Fire Protection. Fire departments are located in individual cities. No county service is provided.

Public Works

Sanitation Pickup and Disposal. Services are franchised out to private haulers in each of four areas. The service is paid for by users. There are three landfill sites.

Education

Schools. Eight-hundred people are employed by the county school system as follows: 550 teachers, 90 busdrivers, 15 maintenance and mechanical, 100 clerical and miscellaneous help. There are 11,000 students in twenty school buildings.

Libraries. There are eight community libraries and one book mobile in the county. The county library is a shared facility with the town library at the county seat (Columbiana). This facility has one full-time and one part-time librarian as well as five clerical staff. The county budgets $45,600 for library activities. The county library of Columbiana has a budget of $77,800 which includes a town contribution. The county provides materials and processing for the local units, while the towns provide buildings and payrolls. Towns with facilities are: Columbiana, Willsonville, Montevallo, Calero, Alabaster, Vincent, Pelham, Helena.

Health and Welfare

Hospitals, Clinics, Nursing Homes. The county has one hospital, Shelby Memorial; one nursing home, Briarcliff Nursing Home (private) (both hospital and nursing home are in Alabaster); one clinic for overnight care; two or three beds (located in Colbra). The following services are provided by the Health Department: immunization, home health care, family planning, food inspection, dairy inspection; subdivision development control (covers inspection of septic tanks). This department employs 12-14 professionals and 20 people in total.

Welfare Services. The county maintains a pensions and securities department.

Administrative Facilities

The county maintains the following departments: planning, public works, tax assessors office.

Government Structure

The Probate Judge is chairman of the county commission. There are four additional commissioners, each responsible for a district. They meet twice a month.

Jefferson County

As the most urbanized of the three counties in the watershed, Jefferson has available considerably more in the way of services and facilities than the other two.*

Public Safety

Police Protection. The Jefferson County Sheriff's Department provides law enforcement services to the people living in unincorporated areas of the county. Some small municipalities which do not maintain their own police departments also receive patrol services from the county. The department maintains four substations; of these four, the Cahaba Heights facility lies within the study area.

The Sheriff's Department maintains the following staff, by division:

Patrol Division	Uniformed:	112
	Civilian:	0
Criminal Division	Uniformed:	25
	Civilian:	5
Civil Division	Uniformed:	31
	Civilian:	10
Technical Division	Uniformed:	8
	Civilian:	24
Jail Division	Uniformed:	58
	Civilian:	11
Subtotal	Uniformed:	234
	Civilian:	50
Total		284

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*Source for all information for Jefferson County, unless otherwise noted: "Community Facilities Inventory and Analysis" issued by Jefferson County Planning and Community Development Office, June, 1976.

PART B. MAN-MADE ENVIRONMENT

AI-78

There are approximately 160,000 persons served in unincorporated sections of county by the sheriff's department. The manpower per 1000 population is 1.8.

In addition to the services of the Sheriff's Department; the following cities within the study area maintain a police department:

Hoover has 13 full-time personnel for 3495 people, or 3.7 per 1000.

Leeds has 15 full-time and 8 part-time personnel for 8098 people or 2.3 per 1000.*

Mountain Brook has 44 full-time personnel for 2642 people or 16.7 per 1000.

Trussville has 8 full-time personnel for 3260 people or 2.5 per 1000.

Fire Protection. This service is provided both by municipal fire departments and by county fire departments. The twelve county fire districts serve people in the unincorporated areas; however, coverage is not complete and approximately 84,000 people in the county have no organized fire protection service. There is an informal agreement that the nearest municipal department or county fire district able to respond will provide service. However, this obligation is not binding. District service is paid for through fees levied on property owners.

Manpower for fire protection for the county districts within the study area is as follows:

Bluff Park has 8 full-time and 22 volunteer fireman for 10,500 people (0.8 per 1000 full time and 2.1 per 1000 volunteer).

Cahaba Heights has 17 volunteers for 5,296 people, or 3.2 volunteers per 1000.

Rocky Ridge has 10 full-time and 19 volunteer fireman; serving 8968 people or 1.1 full-time and 2.1 volunteers per 1000.

Municipal fire departments are maintained by the following towns within the study area:

Hoover maintains a department with 12 full-time and 15 volunteer firemen serving 3495 people, or 3.4 full-time per 1000 and 4.3 volunteers per 1000.

Irondale maintains a department with 4 full-time and 20 volunteer firemen serving 2843 people, or 1.4 full-time per 1000 and 7.0 volunteer per 1000.

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*Weighing part-time as .5 full-time.

Leeds fire department has 4 full-time, 2 part-time and 19 volunteer firement serving 8098 people, or 2.5 full-time per 1000 and 2.3 volunteer per 1000.

Mountain Brook fire department has three stations, totalling 46 full-time firemen serving a population of 20,642 or 2.2 full-time per 1000.

Trussville fire department has a staff of 25 volunteers serving 3260 people or 7.7 volunteers per 1,000.

Vestavia fire department employs 36 full-time firemen serving 12,500 people, or 2.9 firemen per 1000.

Health and Welfare

Hospitals, Clinics, Nursing Homes. Jefferson County has 16 hospitals which provide over 4,400 beds. None of these are located in the study area. There are also numerous clinics or health centers throughout the county. The one in Leeds is the only one in the watershed.

The Jefferson County Health Department also provides dental and medical facilities by means of mobile clinics, which service rural areas of the county. The bureaus within the Health Department are: Communicable Disease, Dental Care, Environmental Health, Maternal and Infant Care, Nursing Nutrition and Vital Statistics.

Also available within the county are facilities for the treatment and care of the blind, vocationally disabled and the homebound, narcotics addicts, the mentally ill and the retarded. Lastly, 36 nursing homes provide 3,573 beds for care of the aged.

Education

Schools. Jefferson County has nine separate school systems which maintain 201 active schools with a combined enrollment of 123,250 students.

Within the study area, Mountain Brook maintains six schools, with 225 teachers serving 3,999 students (Student/Teachers Ratio is 19:1).

Vestavia Hills maintains three schools, with 179 teachers serving 3,256 students for a Student/Teacher Ratio of 19:1.

The Jefferson County system itself, both within and without the study area, maintains 71 schools, staffed by 2030 teachers serving 49,345 students, for a Student/Teacher Ratio of 27:1.

Libraries. The Jefferson County Free Library maintains a central warehouse facility of 151,000 books, with a staff of 13 employees. This facility distributes books to local libraries unable to meet local needs. In addition to the above facility, there are seventeen municipal libraries. Those within the study area are:

Irondale -	3 full-time personnel 3 part-time personnel 3.5 books per capita
Leeds -	1 full-time personnel 2 part-time personnel 1.0 books per capita
Mountain Brook -	8 full-time personnel 4 part-time personnel 2.4 books per capita
Trussville -	1 full-time personnel 2 part-time personnel Number of books not available
Vestavia Hills -	7 full-time personnel 2 part-time personnel 2.0 books per capita

Public Works

Sanitation Pickup and Disposal. Jefferson County is divided up into 35 collection districts with one operator on each district. Fees charged homeowners are regulated by the county, but subscription to the service is not mandatory. In addition to these franchised private operators, 23 municipalities have established collection services. Municipalities with their own collection services in the study area are: Irondale, Leeds, Mountain Brook, Trussville, and Vestavia Hills. Manpower levels for the private and municipal services were unavailable.

Solid waste disposal in Jefferson County is handled through sanitary landfill. There are fourteen facilities all tolled, maintained by the county and by municipalities. Two specifically are within or adjoining the watershed; serving the towns of Mountain Brook and Vestavia as well as other municipalities.

Administrative Facilities

In addition to facilities mentioned above, the county supports the following activities: the Jefferson County Courthouse houses administrative offices and courts, a Law Library and Offices for the Bar Association. Also found there are the County Commission Chambers, Offices of the Departments of Public Works, Revenue, etc.

A joint city-county Civic Center was recently completed. It houses a theater, exhibition hall, concert hall, and coliseum.

St. Clair County

The portion of St. Clair County which falls within the study area is very sparsely settled. Three very small towns, Margaret (685 people), Moody (504 people), and Whites Chapel (334 people) maintain facilities as follows:

Margaret: a post office and town hall-4 employees altogether

Moody: a town hall and junior high school-30 employees altogether

Whites Chapel: a town hall-2 employees altogether

BIRMINGHAM WATER WORKS BOARD RATE SCHEDULE

The Water Works Board of the City of Birmingham provides water to the entire Cahaba River EIS study area except for the municipalities of Trussville and Leeds. These municipalities utilize their own wells and distribution system for water supply. The Water Works Board recently adopted the following rate schedule:

Rate Schedule

	Per 100 Cubic Feet
For the first 10,000 cubic feet per month or 30,000 cubic feet per quarter	60¢
For the next 20,000 cubic feet per month or 60,000 cubic feet per quarter	56¢
For the next 35,000 cubic feet per month or 105,000 cubic feet per quarter	48¢
For the next 4,734,998 cubic feet per month or 14,205,000 cubic feet per quarter	35¢
All over 4,799,998 cubic feet per month or 14,400,000 cubic feet per quarter	28.9¢

The rate schedule also provides for a minimum charge of $2.40 per month for 400 cubic feet and $7.20 per quarter for 1,200 cubic feet. Separate rate schedules are applicable to water supplied through meters larger than 5/8 inch, fire service connections and for municipal and public fire hydrants.

The Water Works Board also has a rural rate schedule for water users in the outlying portions of the system. The following represents the charges levied under the Board's rural rate schedule:

Rural Rate Schedule

	Per 100 Cubic Feet
For the first 10,000 cubic feet per month or 30,000 cubic feet per quarter	$1.00
For the next 20,000 cubic feet per month or 60,000 cubic feet per quarter	$ .90
For the next 35,000 cubic feet per month or 105,000 cubic feet per quarter	$ .77
For over 65,000 cubic feet per month or 195,000 cubic feet per quarter	$ .56

The rate schedule also provides for a minimum charge of $4.00 per month for 400 cubic feet and $12.00 per quarter for 1,200 cubic feet. Separate rate schedules are applicable to water supplied through meters larger than 5/8 inch, fire service connections and for municipal and public fire hydrants.

The Industrial Water Board of the City of Birmingham provides water to large volume water users in the Birmingham area. They supply water to many industries in the area and also supply the Water Works Board of the City of Birmingham with some of their water. The Industrial Water Board recently adopted the following water rate schedule:

Average Daily Consumption Based on Monthly Meter Readings	Net Rate per 100,000 Gallons
First 100,000 gallons or less	$29.70
Next 200,000 gallons or less	$28.35
Next 200,000 gallons or less	$27.00
Next 500,000 gallons or less	$25.65
Over 1,000,000	$24.30

MAJOR REVENUE PROVISIONS OF THE 1977
JEFFERSON COUNTY SEWER ORDINANCE

Single-Family Residential - A uniform volume charge of $.30 per hundred cubic feet of water consumption returned to the stream. The uniform volume charge is levied on the basis of 85% of the metered water consumption.

Other Domestic Users - A uniform volume charge of $.30 per hundred cubic feet of metered water consumption is levied for all domestic usage other than single-family residential.

Other Users - A uniform volume charge of $.30 per hundred cubic feet of metered water consumption is levied for all other discharges in which pollutant concentration does not exceed the domestic maximum. For loadings which exceed the specified standards an industrial surcharge will be levied.

Minimum Charges - Minimum quarterly and monthly charges are levied as follows:

Meter Size	Minimum Charge	
	Quarterly	Monthly
5/8	3.60	1.20
3/4	4.50	1.50
1	9.00	3.00
1-1/4	12.00	4.00
1-1/2	15.00	5.00
2	25.50	8.50
3	48.00	16.00
4	79.50	26.50
6	156.00	52.00
8	315.00	105.00
10	360.00	126.00
12	477.00	159.00

Impact Connection Fees - Domestic Users - An impact connection fee is levied upon each new connection to the sewer system. The fee is determined at the rate of $300 per equivalent residential unit (ERU). An ERU is defined as a connection discharging 125 hundred cubic feet of typically domestic effluent annually. On the basis of typical discharge patterns the following ERU factors are utilized:

Usage Classification	ERU Factor
Single-family residential	1.00
Multi-family residential	
One bathroom	0.50
More than one bathroom	0.75
Mobile Home	
Standard	0.75
Doublewide	1.00
Hotel/Motel (per room)	0.50
Recreation vehicle pad	0.75
Restaurant (per seat)	0.15

Other - to be determined by Director of Public Works

Non-Domestic Users - Any connection to the system which is non-domestic by virtue of the volume or rate of flow or level of pollutant concentrations will warrant an impact connection fee as determined by the Director of Public Works on a case-by-case basis. The Director will base his determination upon all factors which significantly influence the consumption of system capacities including the following calculation of an ERU factor:

Number of ERU's = Projected annual volume charge + projected annual industrial surcharge divided by $37.50 where $37.50 = the volume charge for 125 hundred cubic feet of typically domestic effluent.

Industrial Waste Surcharges - In addition to the regular sewer service charge the county also levies an industrial surcharge. These surcharges are in addition to regular sewer service charges and are an attempt to defray the added costs associated with treating high strength wastewater. An industrial waste surcharge shall be assessed against any industry in the county service area whose wastewater characteristics exceed the following normal wastewater strengths:

BOD	300 ppm
Suspended Solids (ss)	300 ppm
Grease	50 ppm
Detergents	8 ppm
Total Phosphates	8 ppm

Industrial waste is considered any effluent with pollutant loadings in excess of the above standards. The industrial waste surcharge shall be determined by application of the following rates:

1. BOD_5 - $.07 per lb. in excess of 300 ppm.

2. SS - $.03 per lb. in excess of 300 ppm.

3. At the discretion of the Director of Public Works, on a case-by-case basis, concentrations of grease, detergents, total phosphates (in excess of the concentrations set out above) or other pollutants will be assessed on industrial waste surcharge based upon the higher cost of treatment of the discharge.

TABLES

MAN-MADE ENVIRONMENT

TABLE AI-19

COMPARISON OF EMPLOYMENT BY MAJOR INDUSTRIAL CATEGORY
FOR THE UNITED STATES, ALABAMA AND THE BRPC REGION
1960-1970

Employment Category	United States				Alabama				BRPC Region			
	Number Employed		Percent Employed		Number Employed		Percent Employed		Number Employed		Percent Employed	
	1960	1970	1960	1970	1960	1970	1960	1970	1960	1970	1960	1970
Agriculture	4,349,884	2,840,488	6.9	3.5	104,855	46,299	9.6	3.6	6,902	4,574	2.5	1.5
Mining	654,006	630,788	1.0	1.0	11,902	8,843	1.1	.8	8,930	5,076	3.4	1.6
Construction	3,815,942	4,572,235	5.9	6.0	71,359	82,076	6.7	6.4	16,245	18,201	6.1	6.1
Manufacturing	17,513,086	19,837,208	27.1	25.9	282,992	341,575	26.6	26.8	71,884	74,970	27.1	25.4
Trade, Communications and Utilities	4,458,147	5,186,101	6.9	6.8	62,990	79,469	6.0	6.2	20,145	23,775	7.6	8.1
Trade	11,792,635	15,372,880	18.2	20.1	180,743	226,431	17.0	17.8	51,976	64,242	19.6	21.8
Finance, Insurance and Real Estate	2,694,630	3,838,387	4.1	5.0	31,886	43,817	3.0	3.4	12,230	15,795	4.6	5.4
Services	11,012,559	15,750,836	17.0	20.6	237,839	377,841	22.3	29.6	60,047	76,403	22.6	25.9
Government	5,740,278	8,524,676	8.9	11.1	59,119	69,203	5.6	5.4	9,217	12,280	3.5	4.2
Other *	2,608,085	--	4.0	-	22,212	--	2.1	-	8,027	--	3.0	-
Total	64,639,247	76,553,599	100.0	100.0	1,065,987	1,275,554	100.0	100.0	265,603	295,316	100.0	100.0

*Industries not reported for 1960 only

Sources: Census of Population, 1960 and 1970

Final Report Volume II on A Regional Economic Base Analysis of the Birmingham Six-County Planning Region, Battelle Columbus Laboratories, June 30, 1976

TABLE AI-20

COUNTY EMPLOYMENT CHARACTERISTICS
1970

Employment Category	Jefferson County Number Employed 1960	Jefferson County Number Employed 1970	Jefferson County Percent Employed 1960	Jefferson County Percent Employed 1970	Shelby County Number Employed 1960	Shelby County Number Employed 1970	Shelby County Percent Employed 1960	Shelby County Percent Employed 1970	St. Clair County Number Employed 1960	St. Clair County Number Employed 1970	St. Clair County Percent Employed 1960	St. Clair County Percent Employed 1970
Agriculture	1,457	1,529	.8	.6	666	529	6.8	4.0	686	320	8.9	3.4
Mining	5,812	3,146	2.7	1.2	365	214	3.7	1.6	72	31	1.0	.3
Construction	11,661	12,742	5.4	5.4	976	1,322	10.0	9.4	700	858	9.1	9.4
Manufacturing	59,241	57,289	27.2	24.1	3,154	4,084	32.3	30.7	2,707	3,281	34.9	35.9
Transportation, Communications and Utilities	16,958	19,146	7.8	8.1	694	894	7.1	6.7	389	692	5.0	7.6
Trade	44,299	53,848	20.3	22.6	1,334	2,573	13.7	19.3	1,167	1,497	15.1	16.4
Finance, Insurance and Real Estate	11,307	14,181	5.2	6.0	202	425	2.1	3.2	177	233	2.3	2.6
Services	51,830	65,829	23.8	27.7	1,936	2,880	19.8	21.6	1,239	1,714	16.0	18.7
Government	7,670	10,134	3.5	4.3	273	403	2.8	3.0	418	524	5.4	5.7
Other *	7,185	—	3.3	-	169	—	1.7	-	181	—	2.3	-
Total	217,844	237,844	100.0	100.0	9,769	13,324	100.0	100.0	7,736	9,150	100.0	100.0

*Industries not reported for 1960 only

Sources: Census of Population, 1960 and 1970

Final Report Volume II on A Regional Economic Base Analysis of the Birmingham Six-County Planning Region, Battelle Columbus Laboratories, June 30, 1976

TABLE AI-21

EMPLOYMENT CHARACTERISTICS FOR MUNICIPALITIES IN THE STUDY AREA
1970

Employment Category	Irondale	Trussville	Leeds	Vestavia Hills	Homewood	Mountain Brook	Birmingham
Construction	10.8	4.3	4.8	3.8	3.2	3.3	4.9
Manufacturing	20.4	22.0	43.8	17.7	12.7	14.0	21.6
Transportation, Communications and Utilities	5.5	10.6	5.8	6.4	7.1	5.3	8.6
Trade	28.4	23.1	19.8	24.7	25.5	25.7	23.1
Finance, Insurance and Real Estate	5.2	9.9	6.5	14.9	13.5	17.6	8.8
Professional Services	13.3	18.1	10.1	24.9	22.9	25.9	10.5
Public Administration	4.1	4.9	3.0	3.7	4.2	2.5	4.6
All Other	12.3	7.2	6.0	3.9	10.5	5.2	17.9
Total Employment	1,238	1,157	2,495	3,291	9,488	7,070	114,725

Source: U. S. Bureau of the Census. General Social and Economic Characteristics: Alabama PC (1)-C2.
Census of Population, 1970, Washington, D.C.

TABLE AI-22

INCOME COMPARISON
1960-1970

	Aggregate Personal Income				Per Capita Income				Median Family Income			
Level of Government	1960	1970	Change 1960-1970	Average Annual Growth Rate	1960	1970	Change 1960-1970	Average Annual Growth Rate	1960	1970	Change 1960-1970	Average Annual Growth Rate
United States	331,665,000	633,820,960	302,155,960	6.7	1,850	3,119	1,269	5.4	5,660	9,586	3,926	5.4
Alabama	4,070,000	7,980,130	3,910,130	7.0	1,246	2,317	1,071	6.4	3,937	7,266	3,329	6.3
BRPC Region	1,212,000	2,171,866	959,866	6.0	1,519	2,651	1,132	5.7	-	-	-	-
Jefferson County	1,046,000	1,819,520	773,520	5.7	1,648	2,821	1,173	5.5	5,103	8,562	3,459	5.3
Shelby County	35,000	83,377	48,377	9.1	1,089	2,192	1,103	7.3	3,706	7,155	3,449	6.8
St. Clair County	24,000	55,073	31,073	8.7	945	1,970	1,025	7.6	3,496	6,461	2,965	6.3

Sources: County and City Data Book 1960, 1970

U.S. Census of Population 1960, 1970

Final Report Volume II on A Regional Economic Base Analysis of the Birmingham Six-County Planning Region, Battelle Columbus Laboratories, June 30, 1976

TABLE AI-23

INCOME CHARACTERISTICS FOR MUNICIPALITIES IN THE STUDY AREA
1970

	Irondale	Trussville	Leeds	Vestavia Hills	Homewood	Mountain Brook	Birmingham
Total Income ($1,000)	8,118	10,164	1,653	4,719	3,777	15,850	77,545
Median Family Income	7,980	10,652	7,562	16,816	10,063	21,163	7,737
Per Capita Income	2,564	3,405	2,365	5,673	2,652	8,139	2,577
Mean Wage/ Salary	9,060	9,758	8,142	15,811	10,445	20,069	8,223
Percent on Public Welfare	0.8	0.6	1.3	0.3	0	0.1	1.8
Percent Below* Poverty Level	14.8	4.2	14.3	2.2	1.0	2.2	17.4

*Percent of Families

Source: U.S. Bureau of the Census. General Social and Economic Characteristics: Alabama PC (1)-C2.

Census of Population, 1970

TABLE AI-24

LABOR FORCE CHARACTERISTICS

	Jefferson County	Shelby County	St. Clair County
Labor Force			
Total	248,259	13,861	9,541
14-17	5,928	431	346
18-24	42,453	2,776	1,557
25-34	51,152	3,110	2,270
35-44	52,317	2,769	2,049
45-64	86,710	4,284	3,018
65+	9,699	490	301
Female	95,407	4,847	3,102
Unemployed (Percent)	4.2	3.9	4.1

Sources: Report Volume III-A on Tabular Summaries of Demographic - Economic Projections for the Birmingham Six-County Planning Region, Battelle Columbus Laboratories, June 21, 1976

U.S. Bureau of the Census, General Social and Economic Characteristics, Alabama PC (1)-C2. Census of Population, 1970

TABLE AI-25

LABOR FORCE CHARACTERISTICS FOR MUNICIPALITIES IN THE STUDY AREA

	Irondale	Trussville	Leeds	Vestavia Hills	Homewood	Mountain Brook	Birmingham
Labor Force							
Total Labor Force	1,305	1,192	2,590	3,331	9,739	7,214	120,562
Males/Females Over 16	540/377	803/389	1,675/915	2,343/988	5,552/4,172	5,032/2,182	69,201/51,361
Unemployment/Rate	20/2.1	35/2.9	95/3.6	40/1.2	254/2.6	144/2.0	5,837/4.8
Male Labor Force Participation Rate	74.6	81.9	77.7	83.0	77.3	81.6	73.6
Female Labor Force Participation Rate	38.2	34.9	36.2	30.8	46.5	29.7	42.8
Percent Agricultural Employment	5.2	0.0	0.0	0.0	0.17	0.13	0.5
Occupation (Percent)							
Professional and Technical	9.4	17.4	9.9	30.2	27.1	32.1	12.3
Managers and Administrators	11.8	11.5	7.6	24.9	15.3	29.6	6.9
Sales	8.1	11.4	5.2	15.5	14.6	17.3	7.8
Clerical	14.5	19.2	15.5	17.9	23.5	14.0	19.4
Craftsmen	18.3	18.5	19.0	5.8	7.4	2.8	13.1
Transport	2.7	2.8	3.7	0.3	1.1	0.7	5.0
Laborers excluding Farm	5.6	1.4	4.8	1.2	1.8	0.4	6.1
Farmers	0.4	0	0	0	0.17	0.13	0.2
Service Workers	14.1	9.9	9.7	2.9	4.8	1.0	13.1
Private Household Workers	3.7	0	2.4	0.4	1.7	0.8	4.6
Education							
Median Years Completed	10.3	12.2	10.6	14.0	12.8	15.2	11.1
Percent High School/College	31.9/4.9	52.4/10.9	34.3/2.3	38.7/34.9	74.9/24.9	90.1/45.0	44.0/7.4
Illiteracy Rate	10.6	4.0	9.2	0.7	3.1	0.4	8.7

Source: U.S. Bureau of the Census, General Social and Economic Characteristics, Alabama PC (1)-C2. Census of Population, 1970.

TABLE AI-26

NUMBER OF ESTABLISHMENTS
1973

Employment Category	Alabama		Region		Jefferson		St. Clair		Shelby	
	Total	Twenty Plus Employees	Total	Twenty Plus Employees	Total	Twenty Plus Employees	Total	Twenty Plus Employees	Total	Twenty Plus Employees
Agriculture	680	44	105	9	75	5	2	0	11	2
Mining	201	80	79	40	48	22	1	1	3	1
Construction	5,415	723	1,339	239	1,022	216	35	4	94	10
Manufacturing	4,663	1,764	963	414	722	328	34	9	72	33
Trans.,Communications and Utilities	2,075	424	418	117	300	99	24	3	29	7
Trade	21,534	2,370	4,765	734	3,797	699	150	8	192	16
Finance, Insurance and Real Estate	4,404	517	1,256	159	1,116	138	16	1	33	4
Services	14,165	1,128	3,655	384	3,205	359	55	5	96	5
Unclassified	1,402	38	239	11	178	9	10	0	15	0
Total	54,539	7,088	12,819	2,107	10,463	1,845	327	31	545	78

Sources: County Business Patterns, U. S. Department of Commerce, Bureau of the Census

Final Report Volume II on A Regional Economic Base Analysis of the Birmingham Six-County Planning Region, Battelle Columbus Laboratory, June 30, 1976

TABLE AI-27
ANALYSIS OF COAL SEAMS IN THE CAHABA COAL FIELD

Seam	Moisture Per Cent	Vol. Matter Per Cent	Carbon Per Cent	Ash Per Cent	Sulfur Per Cent	B.T.U.
Black Shale	4.6	35.1	57.9	2.4	0.6	14,210
Glass	2.5	31.0	54.6	11.9	0.7	13,030
Gould	2.0	30.2	59.0	7.9	1.8	13,620
Harkness	2.3	32.9	54.7	10.1	2.0	13,320
Helena	3.7	33.5	54.4	8.4	0.6	13,230
Henry Ellen	2.5	33.1	52.9	11.4	0.9	13,090
Nunnally	2.2	34.4	55.4	8.0	1.0	13,570
Thompson	3.0	35.3	54.8	6.9	0.6	13,520
Wadsworth	-	36.0	60.0	3.7	0.8	14,830

Source: Alabama Department of Industrial Relations, Division of Safety and Inspection, Annual Statistical Report, Fiscal Year 1975-1976.

TABLE AI-28

PRIVATELY OWNED WASTEWATER COLLECTION AND TREATMENT SYSTEMS

Owner	Size	Location
Subdivisions		
Inverness	200,000 GPD currently has a request to expand with an ultimate goal of approximately 400,000 GPD	Shelby County - Located on State Rt. 17 southwest of U.S. 280.
Altadena	90,000 GPD currently has a request to construct 70 additional apartment units	Shelby County - Located adjacent to Inverness.
Cahaba Heights Estates	20,000 GPD	Jefferson County - Northeast of Irondale.
Eastwood Mobile Homes	45,000 GPD	Jefferson County - Northeast of Irondale.
Plaza Mobile Homes	14,000 GPD	Jefferson County - Northeast of Irondale.
London Village Mobile Homes	65,000 GPD	Jefferson County - West of Trussville
Vann Trailer Park	15,000 GPD	Jefferson County - West of Trussville.
Chateau Orleans	35,000 GPD	Jefferson County - South of Mt. Brook.

TABLE AI-28 (Cont'd)

Schools		
Mt. Brook High School	23,000 GPD	Jefferson County - City of Mt. Brook
Rocky Ridge Elementary School	20,000 GPD	Jefferson County - Southeast of Vestavia Hills
Gresham Junior High School	25,000 GPD	Jefferson County - South of Mountain Brook
Industry		
Gold Kist	1,080,000 GPD	Jefferson County - East of Trussville
Country Club		
Pine Tree Country Club	15,000 GPD	Jefferson County - East of Irondale
Proposed Facilities		
Riverchase	650,000 GPD	Shelby County - North of Pelham and Helena
Unknown	650,000 GPD	Jefferson County - Northeast of Irondale
Unknown	650,000 GPD	Jefferson County - U.S. 280 crossing of the Cahaba River.

Source: Alabama Water Improvement Commission, March, 1977.

TABLE AI-29

WATER QUALITY AT
SHADES MOUNTAIN FILTER PLANT

Date	Monthly Average Turbidity (TU)* Raw	Finished	Maximum 2-Day Finished Water Turbidity* (TU)
July, 1974	4	.13	.23
January, 1975	31	.13	.23
August, 1975	19	.25	.50
January, 1976	20	.61	1.58
July, 1976	13	.18	.43
January, 1977	25	.77	2.55

* The Maximum Levels in the EPA Interim Primary Drinking Water Regulations are 1.0 TU for a monthly average and 5.0 TU for a two consecutive day average.

Source: Malcolm Pirnie, Inc.

TABLE AI-30

PRODUCTION AT SHADES MOUNTAIN FILTER PLANT

Year	Avg. Daily (mgd)	Maximum Day (mgd)	Maximum Day Date
1967	51.1	67.6	June 19
1968	54.2	75.2	July 1
1969	53.0	71.8	Aug. 26
1970	53.5	70.3	July 3
1971	54.5	65.8	June 14
1972	53.5	70.9	June 8
1973	54.7	69.1	Sept. 24
1974	54.7	71.0	July 2
1975	53.1	64.0	June 24
1976	54.6	72.4	July 26

Source: Malcolm Pirnie, Inc.

TABLE AI-31

SUMMARY OF SUPPLY AND TREATMENT CAPACITIES OF EXISTING AND PROPOSED FACILITIES

Facility	Treatment Capacity		Supply Capacity		Reliable Capacity	
	Avg	Max	Avg	Max	Avg	Max
Existing Facilities (From Table 2)	90	133	N/A	120	80	116
Western (Addition)	10	15	-	-	10	4
Cahaba Pump Station (Additional 20-mgd pump)	-	-	0	20	0	8
Subtotal	100	148	N/A	140	90	128
IWB - Lewis Smith Lake "Certain Improvements"	-	-	N/A	6	0	6
10,000 feet of pipeline	-	-	N/A	5	0	5
Add'l IWB (1982)						
Western (60 mgd total)	-	-	N/A	30	0	0
Putnam (25 mgd total)	-	-	N/A	6.5	0	0
Add'l IWB (1987)						
Carson (25 mgd total)	-	-	N/A	14.5	0	9
Total	100	148	N/A	202	90	148

N.B. All Values are in million gallons per day (mgd).

Source: Water Supply Study for the Water Works Board of Birmingham, Alabama. Malcolm Pirnie, Inc., April, 1977.

TABLE AI-32

SUMMARY OF SUPPLY AND TREATMENT REQUIREMENTS

	Capacities					
	Treatment		Supply		Reliable	
	Avg	Max	Avg	Max	Avg	Max
Water Demand - 2025	115	167	N/A	167	115	167
Capacity of Existing and Proposed Facilities	100	148	N/A	202	90	148
Additional Requirements	15	19	N/A	--	25	19
Required Facilities						
2nd Expansion of Western Filter Plant (1988)	10	15			10	15
3rd Expansion of Western Filter Plant (2004)	10	15			10	15
Total	20	30			20	30
Summary by Treatment Facility (After 2004)						
Shades Mountain	56	80	46	92	46	80
Western	40	60	N/A	60	40	60
Putnam	12	18	N/A	25	12	18
Carson	12	20	N/A	25	12	20
Total	120	178	N/A	202	110	178

Source: Water Supply Study for the Water Works Board of the City of Birmingham, Alabama. Malcolm Pirnie, Inc., April, 1977.

STUDY AREA PROPERTY TAX
RATES PER $100 ASSESSED VALUE

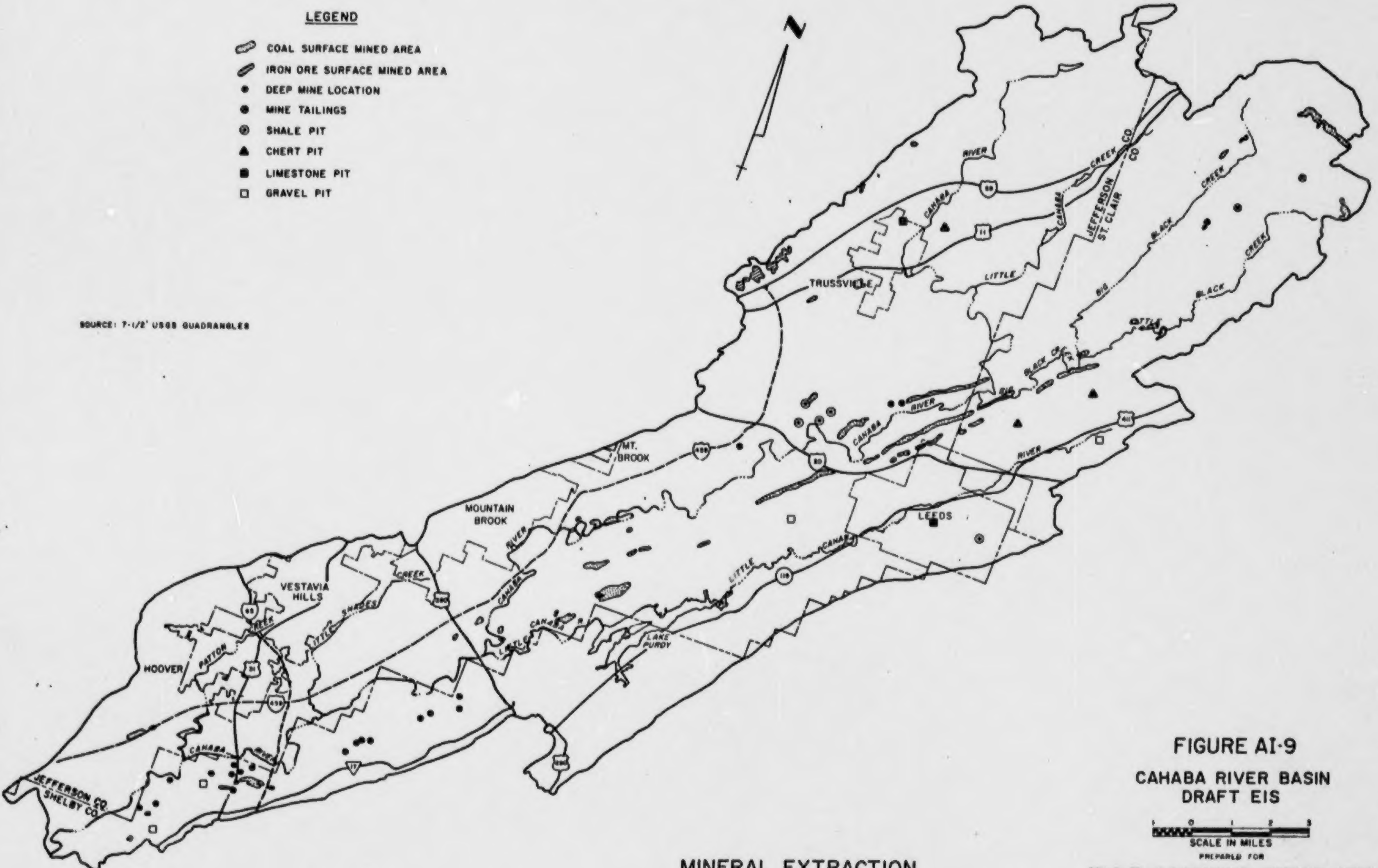
Municipality	State Tax	County Tax	County School Tax	County School District Tax	Special School District Tax	Municipal Tax	Tota
Jefferson County							
Homewood	.65	.95	.60	.70	.40	1.75	5.05
Hoover	.65	.95	.60	.70	.40	---	3.30
Leeds	.65	.95	.60	.70	.40	.65	3.95
Mountain Brook	.65	.95	.60	.70	.40	3.20	6.50
Trussville	.65	.95	.60	.70	.40	---	3.30
Vestavia Hills	.65	.95	.60	.70	.40	2.81	6.11
Outside Any Municipality	.65	.95	.60	.70	.40	---	3.30
St. Clair County							
Outside Any Municipality	.65	1.55	.80	---	---	.50	3.50
Shelby County							
Outside Any Municipality	.65	1.15	.40	.50	.30	---	3.00

Source: Metropolitan Development Board, Birmingham, Alabama, April, 1976.

FIGURES

MAN-MADE ENVIRONMENT

AI-102-a


LEGEND
COAL SURFACE MINED AREA
IRON ORE SURFACE MINED AREA
● DEEP MINE LOCATION
● MINE TAILINGS
⊛ SHALE PIT
▲ CHERT PIT
■ LIMESTONE PIT
□ GRAVEL PIT
N
TRUSSVILLE
CAHABA
RIVER
LITTLE
JEFFERSON
ST. CLAIR
CO
CO
CREEK
BIG
BLACK
CREEK
LITTLE
BLACK CR.
MT. BROOK
MOUNTAIN BROOK
LEEDS
VESTAVIA HILLS
HOOVER
PATTON
CREEK
SHADES
LAKE PURDY
JEFFERSON CO.
SHELBY CO.
59
11
411
459
280
119
31
65
17
SCALE IN MILES
1 0 1 2 3

SOURCE: 7-1/2' USGS QUADRANGLES

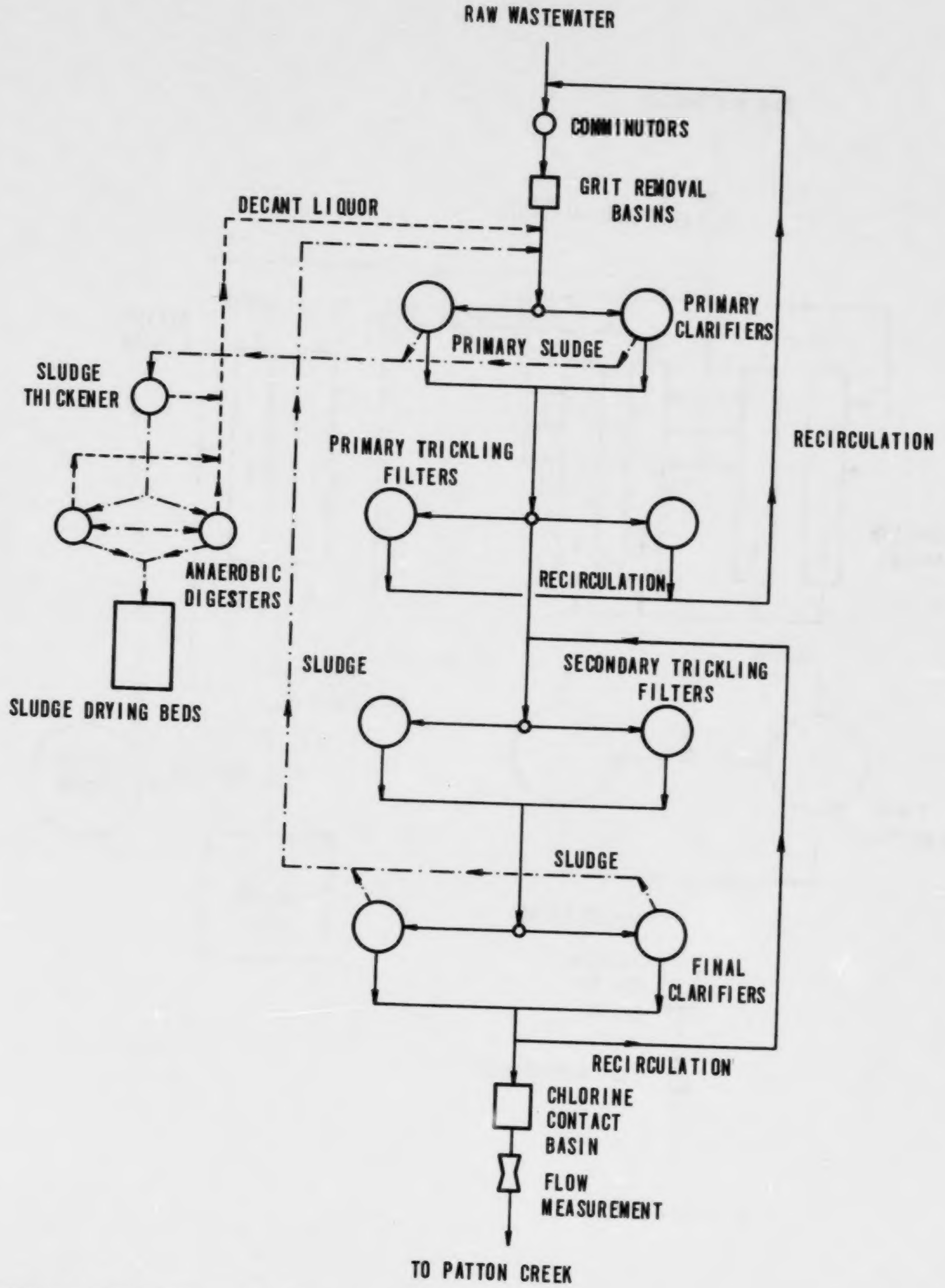
MINERAL EXTRACTION

AI-102-b

FIGURE AI-9

CAHABA RIVER BASIN
DRAFT EIS

PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

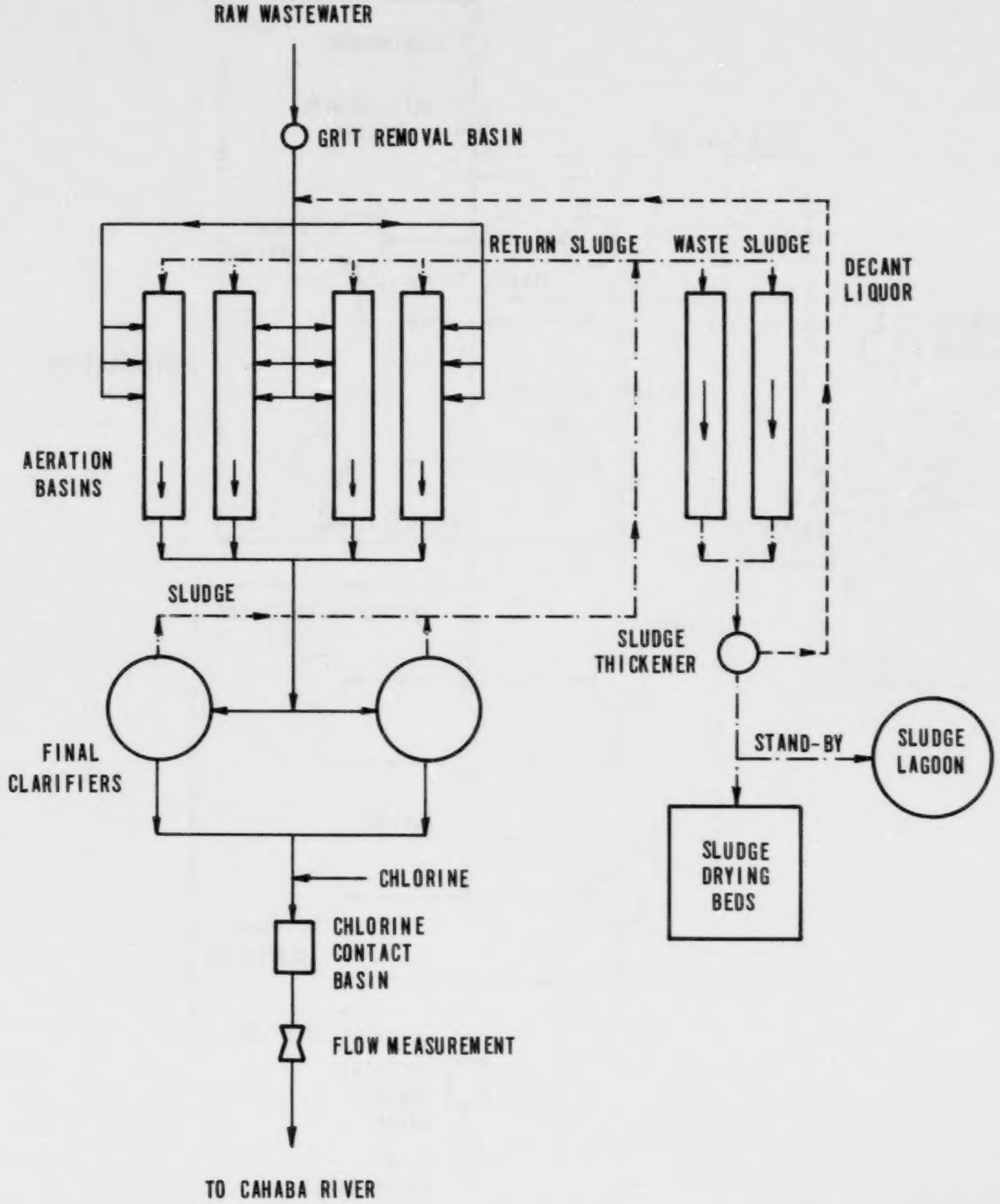

RAW WASTEWATER
COMMINUTORS
GRIT REMOVAL BASINS
DECANT LIQUOR
PRIMARY CLARIFIERS
PRIMARY SLUDGE
SLUDGE THICKENER
RECIRCULATION
PRIMARY TRICKLING FILTERS
RECIRCULATION
ANAEROBIC DIGESTERS
SLUDGE DRYING BEDS
SLUDGE
SECONDARY TRICKLING FILTERS
SLUDGE
FINAL CLARIFIERS
RECIRCULATION
CHLORINE CONTACT BASIN
FLOW MEASUREMENT
TO PATTON CREEK

SOURCE: BIRMINGHAM METROPOLITAN AREA WASTEWATER FACILITIES PLAN,
BLACK CROW EIDSNESS, INC. ENGINEERS, AUGUST 1975

FIGURE AI-10

FLOW DIAGRAM OF THE
PATTON CREEK WWTP

CAHABA RIVER BASIN
DRAFT EIS
PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY


RAW WASTEWATER
GRIT REMOVAL BASIN
RETURN SLUDGE
WASTE SLUDGE
DECANT LIQUOR
AERATION BASINS
SLUDGE
SLUDGE THICKENER
FINAL CLARIFIERS
STAND-BY
SLUDGE LAGOON
SLUDGE DRYING BEDS
CHLORINE
CHLORINE CONTACT BASIN
FLOW MEASUREMENT
TO CAHABA RIVER

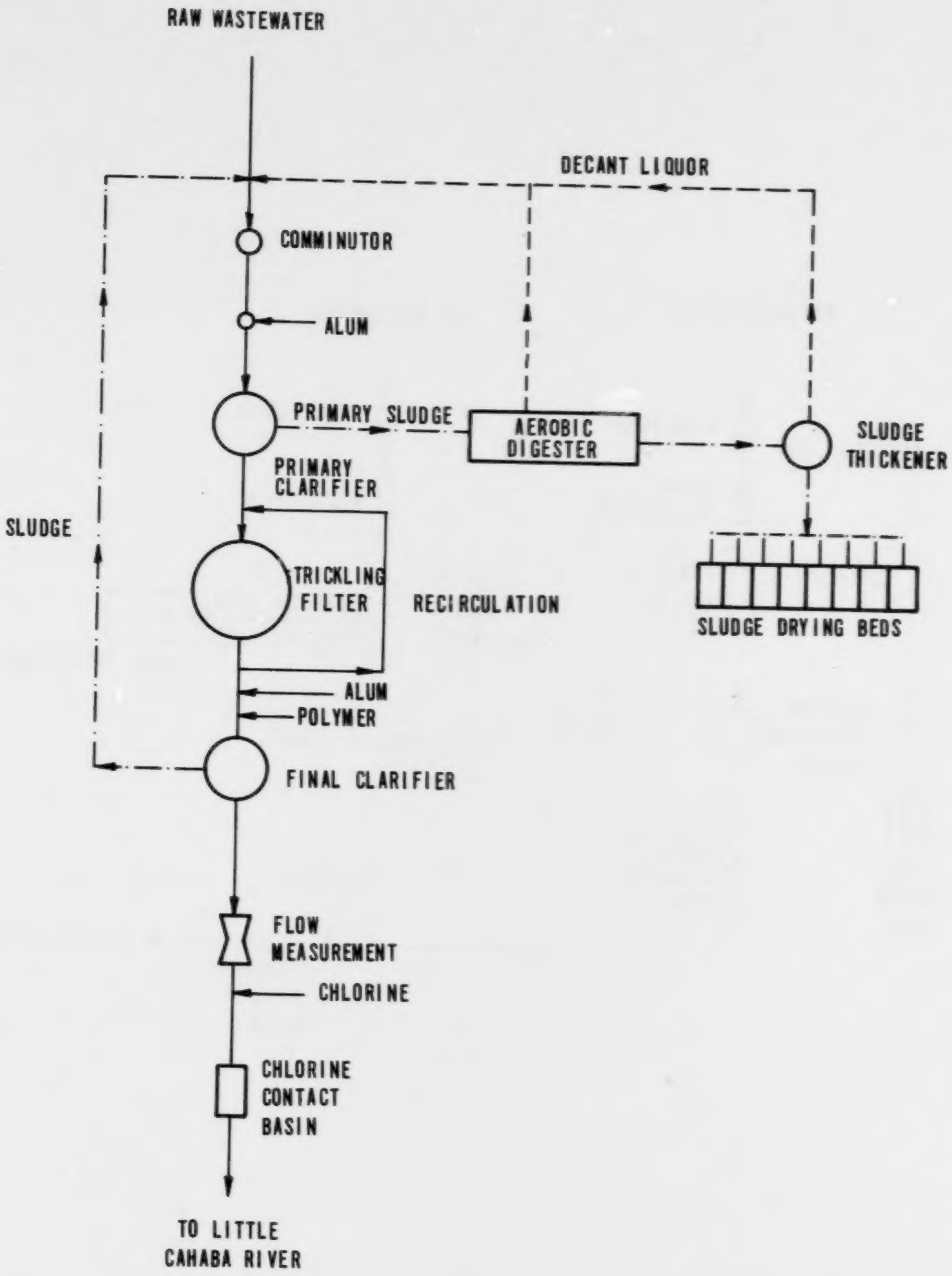
SOURCE: BIRMINGHAM METROPOLITAN AREA WASTEWATER FACILITIES PLAN, BLACK CROW EIDSNESS, INC. ENGINEERS, AUGUST 1975

FIGURE AI-11

CAHABA RIVER BASIN
DRAFT EIS
PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

FLOW DIAGRAM OF THE
CAHABA WWTP

AI-102-d


RAW WASTEWATER
DECANT LIQUOR
COMMINUTOR
ALUM
PRIMARY SLUDGE
AEROBIC DIGESTER
SLUDGE THICKENER
PRIMARY CLARIFIER
SLUDGE
TRICKLING FILTER
RECIRCULATION
SLUDGE DRYING BEDS
ALUM
POLYMER
FINAL CLARIFIER
FLOW MEASUREMENT
CHLORINE
CHLORINE CONTACT BASIN
TO LITTLE CAHABA RIVER

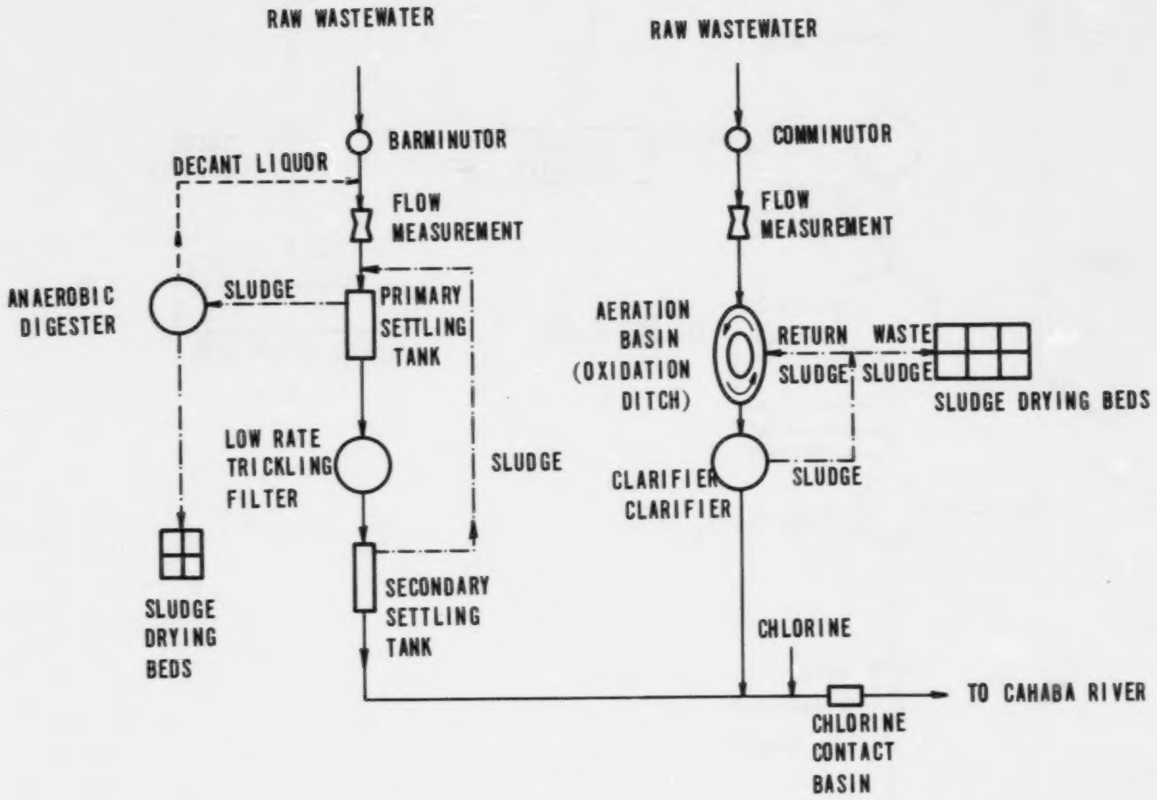
SOURCE : BIRMINGHAM METROPOLITAN AREA WASTEWATER FACILITIES PLAN, BLACK CROW EIDSNESS, INC. ENGINEERS, AUGUST 1975

FIGURE AI-12

CAHABA RIVER BASIN
DRAFT EIS
PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

FLOW DIAGRAM OF THE LEEDS WWTP

AI-102-e


RAW WASTEWATER
BARMINUTOR
DECANT LIQUOR
FLOW MEASUREMENT
ANAEROBIC DIGESTER
SLUDGE
PRIMARY SETTLING TANK
LOW RATE TRICKLING FILTER
SLUDGE
SECONDARY SETTLING TANK
SLUDGE DRYING BEDS
RAW WASTEWATER
COMMINUTOR
FLOW MEASUREMENT
AERATION BASIN (OXIDATION DITCH)
RETURN SLUDGE
WASTE SLUDGE
SLUDGE DRYING BEDS
CLARIFIER
CLARIFIER
SLUDGE
CHLORINE
CHLORINE CONTACT BASIN
TO CAHABA RIVER

SOURCE: BIRMINGHAM METROPOLITAN AREA WASTEWATER FACILITIES PLAN, BLACK CROW EIDSNESS, INC. ENGINEERS, AUGUST 1975

FIGURE AI-13

CAHABA RIVER BASIN
DRAFT EIS

PREPARED FOR

REGION IV U.S. ENVIRONMENTAL PROTECTION AG

FLOW DIAGRAM OF THE TRUSSVILLE WWTP

AI-102-F

APPENDIX II

ALTERNATIVES EVALUATION
AND
IMPACTS ANALYSES

TABLE OF CONTENTS

Page

A. HYDROLOGY AND WATER QUALITY MODELING AII-1
- INTRODUCTION AII-1
- HYDROLOGY AII-2
- QUAL-II AII-13
- CALIBRATION AND VERIFICATION-GFCC WATER QUALITY MODELING AII-17
- QUAL-II PREDICTIONS FOR LOW FLOW CONDITIONS AII-18
- FLOW AUGMENTATION ALTERNATIVES AII-22
- PRELIMINARY LITTLE CAHABA RIVER SIMULATION AII-41
- EPA WATER QUALITY MODELING AII-46

B. COST EVALUATION METHODOLOGY AII-55
- INTRODUCTION AII-59
- COST EVALUATION OF WASTEWATER MANAGEMENT SYSTEMS AII-59
- COST EVALUATION OF OTHER WASTEWATER FACILITIES AII-76

C. OPERABILITY EVALUATION AII-84
- INTRODUCTION AII-84
- EVALUATION CRITERIA AII-84
- EVALUATION PROCEDURES AII-85

D. ENVIRONMENTAL IMPACTS AII-86

E. IMPLEMENTABILITY EVALUATION AII-95
- INTRODUCTION AII-95
- EVALUATION CRITERIA AND PROCEDURES AII-95

F. COST EFFECTIVENESS ANALYSIS METHODOLOGY AII-96
- INTRODUCTION AII-96
- METHODOLOGY AII-96
- COST EVALUATION AII-97
- ENVIRONMENTAL EVALUATION AII-97
- IMPLEMENTABILITY EVALUATION AII-98
- OPERABILITY EVALUATION AII-98
- APPLICATION AII-98

TABLE OF CONTENTS (Cont'd)

Page

G. EVALUATION OF NO-ACTION ALTERNATIVE AII-111

INFILL POPULATION AII-112
DEVELOPMENT TRACT POPULATION AII-112
SCATTER POPULATION AII-115
TOTAL NO-ACTION POPULATION PROJECTIONS AII-117
POPULATION DISAGGRAGATION TO SUBWATERSHED AII-117

H. ESTIMATION OF SEWERED POPULATION BY SUBDRAINAGE BASIN AII-120

I. NON-POINT SOURCE POLLUTION ANALYSIS AII-136

INTRODUCTION AII-136
PROJECTED LAND USE AII-138
MODELING NON-POINT SOURCE POLLUTION AII-138
EXISTING AND PROJECTED NON-POINT SOURCE POLLUTION AII-149
CONCLUSIONS AII-155

LIST OF TABLES

Table		Page
AII-1	Low-Flow Partial-Record Gaging Stations	AII-3
AII-2	Calculation of 7-Day, 10-Year Low Flow Runoff Factors	AII-4
AII-3	7-Day, 10-Year Low Flows - Cahaba	AII-6
AII-4	Stream Gaging Stations	AII-8 - AII-9
AII-5	Summary of the Big Black Creek Reservoir System	AII-12
AII-6	Reaeration Coefficients and Constants for Flow Equation - QUAL-II	AII-16
AII-7	Characteristics of Tributary Flows and Wastewater Discharges - QUAL-II Calibration	AII-19 - AII-20
AII-8	Characteristics of Tributary Flows and Wastewater Discharges - QUAL-II Verification with June, 1977 Barton Lab Data	AII-21
AII-9	QUAL-II Simulations for the Cahaba River - Existing 7-Day, 10-Year Low Flow	AII-23
AII-10	QUAL-II Simulations for the Cahaba River - Existing 7-Day, 10-Year Low Flow	AII-24
AII-11	QUAL-II Simulations for the Cahaba River - Existing 7-Day, 10-Year Low Flow	AII-25
AII-12	Sample QUAL-II Printout	AII-26 - AII-38
AII-13	QUAL-II Simulations for the Cahaba River - Existing 7-Day, 10-Year Low Flow Plus Augmentation Available by Raising Lake Purdy Dam 10 Feet	AII-39
AII-14	QUAL-II Simulations for the Cahaba River - Natural 7-Day, 10-Year Low Flow	AII-40
AII-15	QUAL-II Simulations for the Cahaba River - Augmentation from Proposed Middle Black Creek Reservoir	AII-42
AII-16	QUAL-II Simulations for the Cahaba River - Augmentation from Proposed Big Black Creek Reservoir	AII-43

LIST OF TABLES (Cont'd)

Table		Page
AII-17	QUAL-II Simulations for the Cahaba River - Augmentation from Three Proposed Reservoirs in Big Black Creek Basin	AII-44
AII-18	QUAL-II Simulations for the Little Cahaba River - Existing 7-Day, 10-Year Low Flow	AII-45
AII-19	Construction Cost Estimating Curves	AII-60
AII-20	Operation and Maintenance Cost Estimating Curves	AII-61
AII-21	Breakdown of Project Overhead as a Percentage of Construction and Site Costs	AII-63
AII-22	Unit Process Construction and Project Costs, Cahaba Plant - Leeds-Trussville-Cahaba Alternative	AII-64
AII-23	Unit Process Operation, Maintenance, Materials, and Supply Costs, Cahaba Plant - Leeds-Trussville-Cahaba Alternative	AII-65
AII-24	Spray Irrigation Site Summary	AII-66
AII-25	Spray Irrigation Component Costs	AII-67
AII-26	Flow Augmentation Systems	AII-69
AII-27	Reservoir Costs Summary, Big Black Creek	AII-70
AII-28	Little Black Creek Reservoir - Breakdown of Costs	AII-71
AII-29	Year 2000 - Salvage Value as a Percentage of Initial Construction Costs	AII-73
AII-30	Operation and Maintenance Cost Present Worth Calculations - Alternative: Leeds-Trussville-Cahaba	AII-74
AII-31	Capital and Total Cost Present Worth Calculations - Alternative: Leeds-Trussville-Cahaba	AII-75
AII-32	Construction and Project Cost Estimates for Local Collection Systems	AII-78
AII-33	Jefferson County Wastewater Facilities Operation and Maintenance Costs	AII-79

LIST OF TABLES (Cont'd)

Table		Page
AII-34	Package Treatment Plants for Future Development Tracts	AII-81
AII-35	Septic System Costs - Action/No Action	AII-82
AII-36	Summary of Significant Environmental Impacts	AII-87 - AII-94
AII-37	Cost Effectiveness Rating for Overton-Cahaba	AII-99
AII-38	Cost Effectiveness Rating for Upper Cahaba-Cahaba	AII-100
AII-39	Cost Effectiveness Rating for Leeds-Trussville-Cahaba	AII-101
AII-40	Cost Effectiveness Rating for Leeds (Cahaba R.) - Trussville-Cahaba	AII-102
AII-41	Cost Effectiveness Rating for Trussville-Cahaba	AII-103
AII-42	Cost Effectiveness Rating for Cahaba	AII-104
AII-43	Cost Effectivenss Rating for Patton Creek-Upper Cahaba-Cahaba	AII-105
AII-44	Cost Effectiveness Rating for Patton Creek (via Cahaba River) - Upper Cahaba-Cahaba	AII-106
AII-45	Cost Effectiveness Rating for Upper Cahaba - Cahaba-Patton Creek Pretreatment	AII-107
AII-46	Cost Effectiveness Rating for Upper Cahaba Spray Irrigation - Cahaba	AII-108
AII-47	Cost Effectiveness Rating for Leeds Spray Irrigation - Trussville-Cahaba	AII-109
AII-48	Cost Effectiveness Rating of Alternatives	AII-110
AII-49	Potential Development within Community Boundaries (Infill Populations)	AII-113-114
AII-50	Development Tracts in the Basin	AII-116
AII-51	Scatter Population Projections	AII-118
AII-52	No-Action Population Summary	AII-119

LIST OF TABLES (Cont'd)

Table		Page
AII-53	Percent Sewered Population - Overton-Cahaba	AII-121 - AII-123
AII-54	Percent Sewered Population - Upper Cahaba-Cahaba	AII-124 - AII-126
AII-55	Percent Sewered Population - Leeds-Trussville-Cahaba	AII-127 - AII-129
AII-56	Percent Sewered Population - Trussville-Cahaba	AII-130 - AII-132
AII-57	Percent Sewered Population - Cahaba Alternative	AII-133 - AII-135
AII-58	Nonpoint Source Pollution Characteristics	AII-137
AII-59	Urban Non-Point Source Loads for a Typical Storm Event	AII-139
AII-60	Characteristics of Urban Stormwater	AII-140
AII-61	Existing Land Use	AII-141 - AII-142
AII-62	Land Use Under the Proposed Action - Year 2000	AII- 143- AII-144
AII-63	Temporal Distribution of 6-Hour, 10-Year Storm for Jefferson County, Alabama	AII-146
AII-64	Loading Factors for Urban Runoff Model	AII-148
AII-65	Existing Non-Point Source Pollutant Loads for Selected Parameters - 6-Hour, 10-Year Storm Event	AII- 150- AII- 151
AII-66	Projected Non-Point Source Pollutant Loads for Selected Parameters - 6-Hour, 10-Year Storm Event, Year 2000	AII- 152

LIST OF FIGURES

Figure		Following Page
AII-1	Stream Schematic, QUAL-II Modeling - Cahaba River	AII-15
AII-2	QUAL-II Adjustments at Water Supply Intake - Cahaba River	AII-17
AII-3	Calibration with 1972 AWIC Data - Dissolved Oxygen	AII-20
AII-4	Calibration with 1972 AWIC Data - BOD_5	AII-20
AII-5	Calibration with 1972 AWIC Data - Ammonia	AII-20
AII-6	Calibration with 1972 AWIC Data - Nitrate	AII-20
AII-7	Verification with June, 1977 Barton Lab Data - Dissolved Oxygen	AII-21
AII-8	Verification with June, 1977 Barton Lab Data - BOD_5	AII-21
AII-9	Verification with June, 1977 Barton Lab Data - Ammonia	AII-21
AII-10	Verification with June, 1977 Barton Lab Data - Nitrate	AII-21
AII-11	Stream Schematic, QUAL-II Modeling - Little Cahaba River	AII-44

A. HYDROLOGY AND WATER QUALITY MODELING

INTRODUCTION

This section of Appendix II discusses mathematical modeling of hydrology and water quality of the Cahaba River within the EIS study area. Computer models have been used in this study to simulate the major physical, chemical and biological occurences in the river system. The models employed were adapted to the Cahaba River and were shown to represent past and existing conditions. Therefore, it was possible to use these programs to predict future water quality conditions and to determine required wastewater treatment levels and/or amounts of flow augmentation to prevent serious deterioration of water quality.

Several past studies of the Cahaba River Basin have employed computer models to varying degrees. These efforts are reviewed here as background for the development of the mathematical models used in the EIS preparation.

The Alabama Water Improvement Commission (AWIC), as part of the 303 (e) study of the Cahaba River Basin, used the EPA water quality model SNSIM-II. This model performs a steady-state, one-dimensional simulation of dissolved oxygen, carbonaceous biochemical oxygen demand, and nitrogenous biochemical oxygen demand.

Mr. Ronald Holley, as part of his graduate degree work, continued AWIC's modeling study by doing further work on calibration and verification of the SNSIM-II model. Sensitivity analyses of five of the model's input parameters were also performed by Holley.

Lockheed Missiles and Space Company, Inc., under contract to EPA, adapted the water quality models QUAL and DOSAG to the Cahaba River. Steady-state, one-dimensional simulations of dissolved oxygen, biochemical oxygen demand, the inorganic nitrogen cycle, phosphate, and conservative chemical substances could be performed with these calibrated and verified programs.

In this study, both hydrologic and water quality models were used to evaluate the effects of proposed wastewater treatment and flow augmentation alternatives on water quality of the Cahaba River. The preliminary hydrologic analysis which included use of the U.S., Army Corps of Engineers model HEC-3 is described in this appendix. The capabilities and limitations of QUAL-II, the instream water quality model employed in this study, are given. Use of QUAL-II involved efforts by GFC&C at calibrating and verifying the model with available water quality data. This effort was then refined by the Technical Support Branch of the EPA, Region IV, resulting in a verified model of the reach from the Cahaba WWTP to Buck Creek. The results of both GFC&C's and the EPA's calibration and verification efforts are discussed and illustrated later in this section.

The GFC&C Qual-II model was used as a preliminary evaluation tool for various wastewater treatment and flow augmentation proposals. New NPDES permit, 1983, and year 2000 treatment requirements for the Cahaba Plant were determined by EPA with the refined version of this model. Results of these analyses are summarized here and in Chapter III of the EIS.

HYDROLOGY

Analysis of the hydrology of the Cahaba River Basin was a necessary component of the evaluation of wastewater disposal alternatives. The 7-day, 10-year low flow of the basin was chosen as the critical hydrologic regime for assessment of water quality; therefore, determination of this low flow was required. Included in the wastewater disposal alternatives considered here were several schemes involving flow augmentation from new or expanded reservoirs. Analysis of streamflow and reservoir operation was necessary to quantify the amount of flow augmentation available from these reservoirs.

Low Flow

The 7-day, 10-year low flows were calculated in terms of a low flow runoff factor for the Cahaba River drainage basin and for the Little Cahaba River drainage basin. It was assumed that the ratio of median 7-day low flow to the 7-day, 10-year low flow was constant for the Cahaba River Basin. This ratio was calculated from records available for several low-flow partial-record gaging stations located in or near the study area. A summary of this information is given in Table AII-1. Values of the median 7-day low flow runoff factor on an areal basis were also available.

The ratio defined above is also equal to the ratio of the corresponding runoff factors. This can be seen readily from the following equation:

$$\frac{\text{Median 7-day low flow}}{\text{7-day, 10-year low flow}} = \frac{(\text{Median 7-day low flow runoff factor}) \times (\text{drainage area})}{(\text{7-day, 10-year low flow runoff factor}) \times (\text{drainage area})}$$

$$= \frac{\text{median 7-day low flow runoff factor}}{\text{7-day, 10-year low flow runoff factor}}$$

Therefore, the 7-day, 10-year low flow runoff factor can be calculated by dividing the median 7-day low flow runoff factor by the ratio of the low flows. These calculations for the Cahaba River Basin and the Little Cahaba River Basin are summarized in Table AII-2.

The 7-day, 10-year low flow runoff factor for the Cahaba River was adjusted upward to 0.06 cfsm for several reasons. The estimated median 7-day low flow at the Lovick gage, the only gage in the Cahaba River portion of the study area, was 0.087 cfsm. A 7-day, 10-year low flow value on the order of 0.06 cfsm would reproduce the low flow ratio of 1.4 at the Lovick gage more closely than the calculated value of 0.04 cfsm. Also, downstream portions of the Cahaba Basin and areas adjacent to the Basin all have higher median 7-day low flow runoff factors than the 0.05 cfsm value used in the calculations. Since all these median 7-day low flow runoff factors are given on an average areal basis, it is possible that local runoff factors vary somewhat from these averages.

TABLE AII-1

LOW-FLOW PARTIAL-RECORD GAGING STATIONS

U.S.G.S. Index Number	Gage Name	(a) Median 7-Day Low Flow (cfs)	(b) 7-Day, 10-Year Low Flow (cfs)	Ratio (a)/(b)
02-423300	Cahaba River at Lovick	10.0	7.0	1.4
02-423550	Buck Creek at Helena	17.0	12.0	1.4
02-423398	Little Cahaba River at Leeds	6.2	4.4	1.4

Source: Peirce, L.B., 7-Day Low Flows and Flow Duration of Alabama Streams, Geological Survey of Alabama, Bulletin 87, Part A, University, Alabama, 1967.

TABLE AII-2

CALCULATION OF 7-DAY, 10-YEAR LOW FLOW RUNOFF FACTORS

Basin	Median 7-Day Low Flow Runoff Factor (cfsm)[1]	Ratio of Low Flows[2]	7-Day, 10-Year Low Flow Runoff Factor (cfsm)
Cahaba River	0.05	1.4	0.04
Little Cahaba River	0.35	1.4	0.25

(1) The values given on Plate 3 for the Little Cahaba River Basin were 0.3-0.5 cfsm. 0.35 cfsm was used because the estimated median 7-day low flow at the Leeds gaging station was given as 0.354 cfsm.

(2) See Table AII-1.

Source: Peirce, L.B., 7-Day Low Flows and Flow Duration of Alabama Streams, Plate 3

Gannett Fleming Corddry and Carpenter, Inc.

The 7-day, 10-year low flow runoff factor for the Little Cahaba River was satisfactory as derived. The estimated median 7-day low flow at the Leeds gage was 0.354 cfsm. The derived 7-day, 10-year low flow value of 0.25 cfsm, therefore, produced the desired low flow ratio of 1.4.

Therefore, the 7-day, 10-year low flow runoff factors derived were 0.06 cfsm for the Cahaba River Basin and 0.25 cfsm for the Little Cahaba River Basin. These values have been confirmed independently, as is explained in the next section of this appendix.

Existing and Natural Low Flows

The hydrology of the study area is greatly affected by regulation, particularly during low flow conditions. Just downstream from the confluence with the Little Cahaba River, the Cahaba is impounded by a low-level diversion dam to create the required pool for the Birmingham Water Works Board Intake. During low flow, virtually all of the Cahaba's flow is withdrawn for water supply, releases from Lake Purdy are increased to meet the water supply demand, and almost no water flows over the diversion dam. To account for this altered hydrology, two types of 7-day, 10-year low flow have been identified: natural low flow and existing low flow.

The natural 7-day, 10-year low flow is defined here as the 7-day low flow that has a recurrence interval of 10 years and that would exist in the absence of all impoundments, withdrawals and interbasin transfers. Using the low flow runoff factors derived in the previous section, natural 7-day, 10-year low flows were calculated. At the request of EPA, the U.S. Geological Survey did an independent estimate of the natural low flow*, which agreed closely with the estimates done for the EIS. The U.S.G.S. calculated a flow of 20 cfs in the Cahaba River at U.S. Highway 280 while this study derived a flow of approximately 21 cfs at the same location.

Existing 7-day, 10-year low flows for the Cahaba River were based on the natural 7-day, 10-year low flow with the following differences: 1) flow over the diversion dam was assumed to be nonexistent; 2) flow from the Little Cahaba River included the release from Lake Purdy necessary to meet the water supply withdrawal; 3) upstream of the water supply diversion dam, wastewater treatment plant flows to the Cahaba were considered as additions to the natural low flow, since at low flow the ultimate source of almost all the flow through the treatment plants is the Little Cahaba River Basin. A summary of natural and existing 7-day, 10-year low flows is given in Table AII-3.

Hydrology of Flow Augmentation Alternatives

Determination of the amount of flow augmentation available from the new or expanded reservoirs included in several of the wastewater disposal alternatives was necessary. Analysis of the relevant streamflows and the operation of these reservoirs was performed.

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*Letter to Mr. John Hagan, U.S.EPA, Region IV from Mr. Roy Bingham, U.S.G.S., Tuscalosa, Alabama, July 28, 1977.

TABLE AII-3

7-DAY, 10-YEAR LOW FLOWS - CAHABA

River Mile[1]	Location	Existing (cfs)[2]	Natural (cfs)
180.5	Immediately upstream of Trussville WWTP	1.2	1.2
149.6	At water supply intake	11.4	8.8
147.0	Immediately downstream of diversion dam	0.0	20.7
138.7	Immediately upstream of Cahaba WWTP	1.8	22.5

(1) See Figure AII-1 of this appendix.

(2) This includes estimated average wastewater treatment plant flows for 1977 and assumed no leakage through the diversion dam.

Source: Gannett Fleming Corddry and Carpenter, Inc.

Because there are no unregulated streamflow gages other than partial-record gages on the Cahaba River watershed, records from gages on nearby watersheds having similar hydrologic characteristics were investigated to determine the most appropriate station for transposing to ungaged sites of interest in the Cahaba Basin.

Drainage area, latitude and longitude, location, datum of gage, period of record, and information relating to the accuracy of the discharge records and to conditions that affect the natural flow at the gaging station have been recorded for each station and are presented in Table AII-4.

Since the gages on Hatchet Creek and Turkey Creek had the longest period of record of the gages investigated, the flows at these gages were regressed with the corresponding years of records of the other stations. Results of the regression analysis show the best correlation between the Turkey Creek gage and the Cahaba River gage near Acton, the Acton data adjusted to account for the upstream regulation. The linear regression equation relating the flows at the Cahaba River gage (Y) to the flows at Turkey Creek (X) is:

$$Y = 2.828\,(X) - 27.16$$

with the coefficient of correlation equal to 0.969. Since the correlation between the flows is high, this relationship can be arranged in the following form.

$$\text{Slope of Regression line} = \frac{\text{Q Turkey Creek}}{\text{Q Cahaba River}}\left(\frac{\text{drainage area Turkey Creek}}{\text{drainage area Cahaba River}}\right)^n$$

Substitution of the regression line slope and the drainage areas gives a value of the exponent n equal to 1.002, or essentially unity. This means that flows to any reservoir site in the Cahaba Basin can be reliably simulated using the flow records of the nearby Turkey Creek gage and a ratio of the drainage areas.

With the basis of the hydrologic methodology set, alternative reservoir systems were then evaluated to determine the safe yield. Safe yield is defined in the glossary of Water and Wastewater Control Engineering, 1969 Edition, as: "The maximum dependable draft that can be made continuously on a source of water supply (surface or underground) during a period of years during which the probable driest period or period of greatest deficiency in water supply is likely to occur." This definition applies equally well to reservoirs supplying augmentation releases for water quality control.

Safe yield calculations were performed using the U.S. Army Corps of Engineers' HEC-3 Computer Model. The model is simply a computerized bookkeeping procedure which accounts for reservoir inflows, net evaporation (rainfall-lake evaporation), reservoir releases, and leakage through the dam. All accounting is based on monthly time intervals. All safe yield calculations were based on the assumption that 25 percent of reservoir storage would be held in reserve. This is a generally accepted value in the field of hydraulic engineering. The purpose of this reserve storage is twofold: first, to allow for reservoir sedimentation over the life of

TABLE AII-4

STREAM GAGING STATIONS

USGS Index Number	Gage Name	Drainage Area (sq. mi.)	Period of Record	Latitude/ Longitude	County	Datum of Gage (msl)	Remarks
02-423500	Cahaba River near Acton	230	Oct. 1938- Sept. 1957	33° 21' 48" 86° 48' 48"	Jefferson	375.00	Since 1938 the Birmingham Water Works Board has withdrawn water for water supply from the Board's diversion dam located approximately 11 miles upstream of the gage. Flow partly regulated since 1910 by Lake Purdy, Little Cahaba River.
02-423630	Shades Creek near Greenwood	72.4	Oct. 1964- Sept. 1965; Oct. 1966- Sept. 1973; Oct. 1974- Current	33° 19' 34" 86° 59' 59"	Jefferson	480.37	Records good
02-423800	Little Cahaba near Brierfield	148	Oct. 1957- Sept. 1970	33° 03' 27" 86° 57' 10"	Bibb	325.00	Records good

TABLE AII-4 (Cont'd.)

STREAM GAGING STATIONS

USGS Index Number	Gage Name	Drainage Area (sq. mi.)	Period of Record	Latitude/ Longitude	County	Datum of Gage (msl)	Remarks
02-408500	Hatchet Creek near Brierfield	244	Oct. 1944- Current	32° 56' 42" 86° 13' 06"	Coosa	449.00	Records good
02-456000	Turkey Creek at Morris	81.5	Jan. 1944- Current	33° 44' 25" 86° 48' 45"	Jefferson	345.18	Records good

Source: USGS, Water Resources Data for Alabama, Water Year 1975, USGS Water Data Report AL-75-1
USGS, 1970 Water Resources Data for Alabama, Part 1. Surface Water Records.

the project and, second, to limit drawdown for aesthetic and public health reasons. The critical period of analysis was based on the driest period on record in the area which occured during the 1945 through 1975 water years. Annual net evaporative losses amounted to 42.0 inches per year based on records from U.S. Weather Bureau Class-A pans at Demopolis and Lake Martin, Alabama and a pan coefficient of 0.78. In summary, the HEC-3 model permits a computerized solution to the traditional graphical mass curve analysis of reservoir inflow and demand. The model utilizes an optimization routine to determine the maximum yield of the reservoir, given 75 percent effective volume.

Calculations performed for the portion of the Little Cahaba River watershed impounded by Lake Purdy alone indicated a safe yield of 21 mgd. If water were taken from below Lake Purdy directly, this is the level of supply that could be safely anticipated during the most serious drought during the 1945 through 1975 period of record.

This safe yield figure is based on an average month-to-month release rate during extended periods of reservoir drawdown. In general, the imposition of a variable monthly draft on a reservoir system gives a more realistic picture of the effect of peak demand periods coinciding with low streamflows. However, this condition is not critical for reservoir systems analysis as long as the overall water budget is maintained. HEC-3 maintains a check and balance on the water budget because if variable monthly drafts were modeled, peak monthly release rates would be accompanied by a reduced evaporative loss since an increased drawdown means a smaller reservoir surface area. In addition, average month-to-month demands are justified by the expectation that peak demands would be curtailed during critical periods with the imposition of conservation measures.

To supplement this analysis, ten 50-year periods of monthly streamflow were generated at the Turkey Creek gage and transposed to the Lake Purdy drainage area using the U.S. Army Corps of Engineers' HEC-4 computer model. Statistical simulation is a technique of reproducing the behavior of a system, in this case the monthly streamflows, in conformance with a certain probability distribution based on an analysis of historical streamflow records. HEC-4 computes the mean, standard deviation, skew coefficient, and correlation coefficient for each station and calendar month and then generates hypothetical streamflows by computing a regression equation for each station and month by the Crout matrix method. These ten sets of synthetic streamflows, which have a statistical probability of occurring, indicate a safe yield ranging between 22 and 25 mgd.

Hydrologic modeling indicates the safe yield of the Cahaba River system at the low-head diversion dam to be 46 mgd. This estimate included allowance for the estimated existing leakage of 5.6 mgd through the flashboards at the top of the diversion dam.*

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*Malcolm Prinie, Inc., Water Supply Study, prepared for the Water Works Board of the City of Birmingham, Alabama, April, 1977.

From this point on it has been assumed that any additional storage provided either at Lake Purdy or by new impoundments on the Big Black Creek Basin would be used for low-flow augmentation.

One alternative addressed the feasibility of modifications to the Lake Purdy Dam to provide 10 feet of additional storage on the Little Cahaba. Raising the spillway from elevation 551.0 feet msl to 561.0 feet msl will increase the total storage volume from 5,682 million gallons to about 10,000 million gallons. However, the safe yield of the reservoir is increased only from 33 cfs (21.3 mgd) to 44 cfs (28.4 mgd).

Assuming that the maximum drawdown elevation associated with 75 percent usable volume in the existing reservoir remains fixed for the situation of raising the spillway to elevation 561.0 feet msl, the performance of the two reservoirs can be compared without bias. Effective storage will increase from 4,260 million gallons to 8,580 million gallons. Defining reservoir performance in terms of a storage-yield relationship, the performance ratio for Lake Purdy with existing spillway elevation is 0.20 billion gallons (BG) of storage required for each mgd of yield, while the performance ratio for the reservoir created by raising the spillway 10 feet increases to 0.30 BG per mgd of yield.

The results indicate that a significant increase in effective volume (approximately 100 percent) produces a relatively small increase in safe yield (approximately 33 percent). This can be explained in part by the increase in annual evaporation losses caused by increasing the reservoir surface area.

A system of proposed reservoirs in the Big Black Creek tributary system in St. Clair County, Alabama has been evaluated. The hydrologic feasibility of constructing one or more reservoirs in the Big Black Creek area was examined.

Once again, reservoir inflows to the three reservoir sites were synthesized by transposing the 31-year record (1945 through 1975) from the Turkey Creek gage near Morris, Alabama and adjusting for drainage area ratios. Table AII-5 lists pertinent facts for the Big Black Creek, Middle Black Creek, and Little Black Creek reservoir sites.

Stage and storage curves were obtained for each of the three proposed reservoirs from the 201 Facilities plan prepared by Black, Crow and Eidsness, Inc. Reservoir surface areas were planimetered from USGS 7.5 minute quadrangle sheets.

HEC-3 was run for each of the reservoirs with the safe yield computing to 19 cfs (12.3 mgd) for the Big Black Creek site, 7 cfs (4.5 mgd) for the Middle Black Creek site, and 15 cfs (9.7 mgd) for the Little Black Creek site. As was done to supplement the safe yield calculation at Lake Purdy, HEC-4 was employed to statistically simulate ten periods of 50 years of monthly streamflows to the reservoir system. A statistical model preserves the basic seasonal, cyclic fluctuations of monthly streamflows. These ten sequences of synthetic streamflows indicate a safe yield ranging between

TABLE AII-5

SUMMARY OF THE BIG BLACK CREEK RESERVOIR SYSTEM

Reservoir	Drainage Area (sq. mi.)	Spillway Elevation (feet, msl)	Top of Dam Elevation (feet, msl)	Storage Volume at Spillway (billion gallons)	Surface Area at Spillway (acres)
Big Black Creek	14.8	668	683	9.775	845
Middle Black Creek	6.5	640	655	1.955	220
Little Black Creek	11.7	660	675	5.865	400

Source: Black, Crow and Eidsness, Inc., Birmingham Metropolitan Area Wastewater Facilities Plan, prepared for the Jefferson County Commission, Birmingham, Alabama, August, 1975.

Gannett Fleming Corddry and Carpenter, Inc.

11.6 mgd and 12.9 mgd for the Big Black Creek site, 3.9 mgd and 5.2 mgd for the Middle Black Creek site, and between 8.4 mgd and 10.3 mgd for the Little Black Creek site.

In order to properly assess the additional water supplied by these reservoirs during low-flow conditions, values for the existing 7-day, 10-year low flow have to be accounted for. Estimates of the 7-day, 10-year low flows for the three Big Black Creek tributaries were 1.3 cfs for Big Black Creek, 0.4 cfs for Middle Black Creek, and 0.7 cfs for Little Black Creek.

QUAL-II

Simulation of water quality of the Cahaba River Basin was performed using the mathematical model QUAL-II. QUAL-II is a computer program originally developed by Water Resources Engineers, Inc. for the U.S. Environmental Protection Agency.* The program has the ability to simulate the transport and interaction of various water quality constituents and their effect on dissolved oxygen concentration in streams.

Capabilities

A river basin consisting of a primary river, individual tributaries, point sources of pollutants to these rivers, and incremental inflow to the system can be modeled with QUAL-II. Water quality parameters that can be simulated are dissolved oxygen, biochemical oxygen demand (BOD), organic nitrogen, ammonia, nitrite, nitrate, orthophosphates, coliform bacteria, and conservative chemical substances. In addition to modeling the transport and chemical interaction of potential pollutants, QUAL-II describes instream sources and sinks of these substances, including addition of ammonia, orthophosphates, and BOD from benthic deposits, BOD removal by settling, impact of algal activity on concentrations of ammonia, nitrate, orthophosphates and dissolved oxygen, and effect of atmospheric reaeration on dissolved oxygen.

Several important assumptions are embodied in QUAL-II. In reality, water quality parameters vary with all three spatial dimensions of a river and also with time. However, certain of these variations may be insignificant or information about them may not be required for a particular analysis. In addition, three-dimensional, time-variant models are extremely complex and are not yet reliable tools for water resources engineering; it is therefore desirable to make whatever simplifying assumptions are valid.

QUAL-II is a steady-state model, i.e., a model in which it is assumed that none of the parameters being modeled vary with time. Constant values for flow in the main river and its tributaries and for incremental inflow to the system are used. Municipal and industrial wastewater flows are assumed to be constant point sources. These assumption are generally valid for the level of water quality analysis required for this study.

---

*Roesner, L. A., J. R. Monser, and D. E. Evenson, Computer Program Documentation for the Stream Quality Model QUAL-II, prepared for the Environmental Protection Agency, Systems Development Branch, Washington D.C., May, 1973.

In order to evaluate the impact of various wastewater treatment alternatives on the Cahaba River Basin, the worst case with respect to water quality must be identified. If water quality goals are met for this worst case, then it is not necessary to analyze the system under less severe conditions. The constant 7-day, 10-year low flow in the river system was the worst hydrologic case considered here. Thus, there was no necessity to consider temporal variations of flow and water quality with river stage variations at higher flows. Temporal variations must be considered for surface water bodies which are strongly influenced by tidal action such as estuaries; this is not the case with the Cahaba River.

An additional consideration in the use of a steady state model is the availability of data required to calibrate and verify the model. Adequate data describing flow and water quality of a river system for calibration and verification of a steady-state model are sometimes not available. With a non-steady state model, the data requirements are many times greater and are not likely to be satisfied unless a special data collection effort geared to the needs of non-steady state modeling is undertaken.

The second major assumption made in QUAL-II concerns the number of spatial dimensions with which flow and water quality may vary. The equations describing pollutant transport are averaged over the depth and the width of the river to give one-dimensional predictions along the length of the river. The variation of water quality with depth in a shallow river such as the Cahaba is generally not significant. Variations over the width of the river may be more noticeable, but the greatly increased model complexity and data requirements necessary to account for these variations are not justifiable here. A one-dimensional simulation such as QUAL-II applied with judgment, reasonable factors of safety, and understanding of its limitations provides a valid and useful analytical tool for evaluating wastewater disposal alternatives for the Cahaba River Basin.

River Basin Configuration

The geometry of a river system is represented by a series of computational elements and reaches in QUAL-II. This is a direct result of the finite difference solution required to solve the system of pollutant transport equations used here. The river is divided into discrete nodes (or computational elements, as they are called by Water Resources Engineers, Inc.). Concentrations of the water quality parameters are calculated at each node, these representing average values for small discrete lengths of river.

Computational elements are grouped into reaches, which are stretches of river having constant hydraulic, chemical and biological characteristics. Flows from tributaries, wastewater sources, incremental inflow and headwaters are input to QUAL-II. The model then calculates velocity for each computational element, using an empirical equation of the form:

$$V = aQ^m$$

where V is velocity in feet per second and Q is flow in cubic feet per second. The coefficient and exponent in this equation are determined empirically and are constant for each reach. The reaeration coefficient in the oxygen deficit equation is another major hydraulically-dependent parameter which is constant for each reach. This coefficient may be calculated with one of six empirical formulas included in QUAL-II or may be supplied by the model user.

In the GFC&C modeling effort, the Cahaba River was divided into 103 computational elements of half-mile length. The elements were grouped into 13 reaches with constant properties. These reaches were almost identical to those used by AWIC and by Holley in their modeling studies. A stick diagram of the Cahaba River, as modeled here, is given in Figure AII-1. The river mile numbering system used was derived from previous studies and from USGS 7-1/2 minute quadrangle maps of the region. River mile locations of point sources were rounded off to the nearest one-half mile.

The values used for the constants in the flow equations were derived from low flow information used by AWIC and by Holley in their models. The reaeration coefficients were calculated by Tsivoglou's empirical formula*, a widely accepted formula appropriate for streams like the Cahaba River. This formula is not included as one of the options of QUAL-II. Values of the reaeration coefficients and the constants for the flow equation are summarized in Table AII-6. The velocity coefficients and exponents shown reflect the relatively small variability of velocity with flow in the main channel of the Cahaba River. With approximately constant velocities under different flow regimes, reaeration coefficients did not have to be recalculated for the various alternatives analyzed.

Wastewater Sources and Tributaries

Figure AII-1 shows the point sources which were evaluated in this modeling study. All existing and proposed municipal wastewater treatment discharges were included, as was the Gold-Kist plant in Trussville. Ten major tributaries were included as point sources. Tributaries with drainage areas less than five square miles were treated as incremental runoff, which QUAL-II averages into the river flow over the length of each reach. The Gold-Kist discharge was combined with the flow from Little Cahaba Creek since these discharges are located much closer together than the half-mile computational element length used here and only one point source per computational element is possible.

For analyses which included the wastewater treatment plant on Patton Creek, water quality and flow input for the tributary reflected the effects of the treatment plant. More detailed information about the characteristics of the point sources is given where appropriate in the remainder of this appendix.

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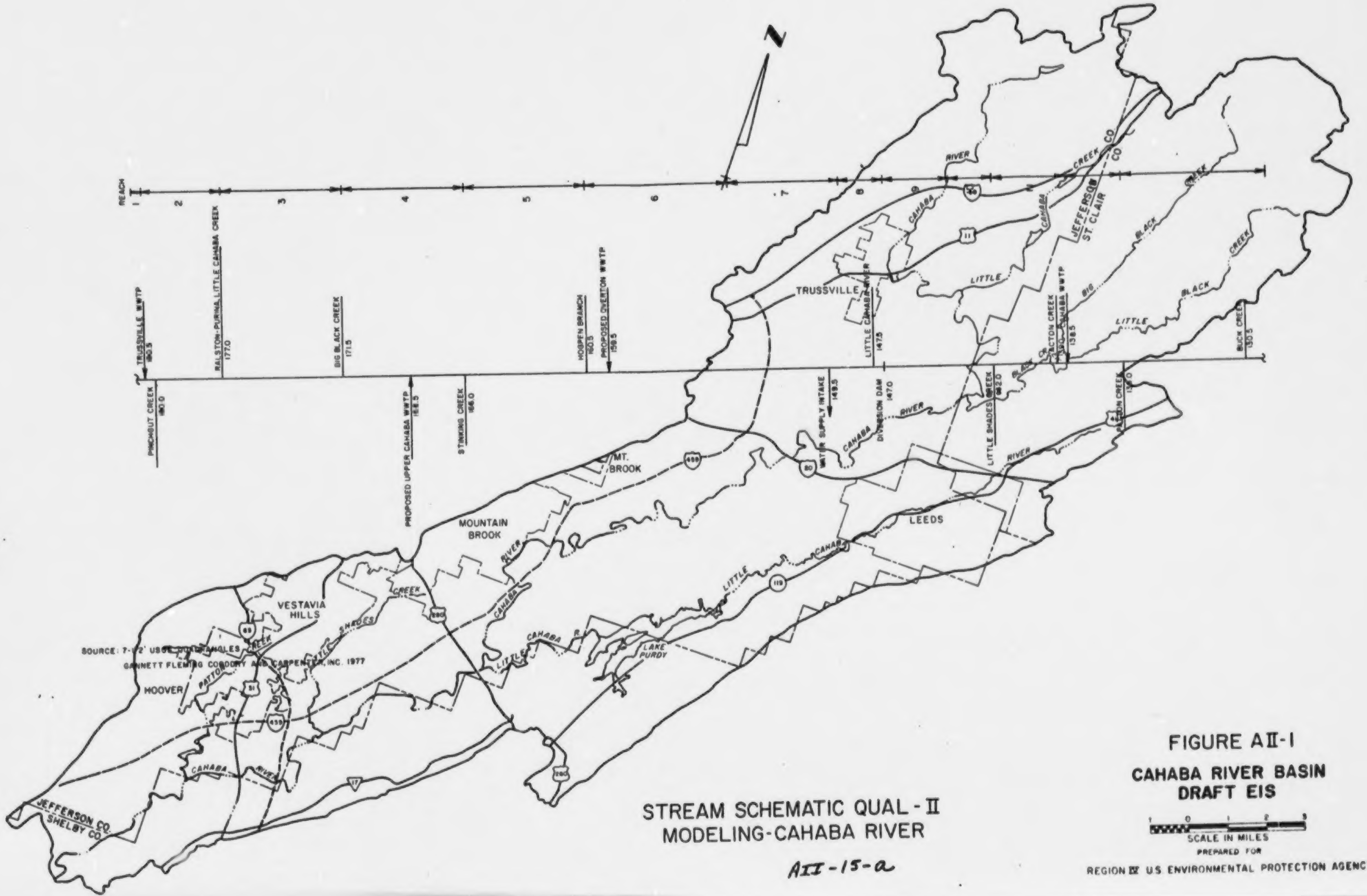
*Tsivoglou, E. and J. Wallace, "Characterization of Stream Reaeration Capacity", EPA-R3-72-012, USEPA, Washington, DC, 1972.


N
REACH
1
2
3
4
5
6
7
8
9
TRUSSVILLE WWTP 180.5
PINCHGUT CREEK 180.0
RALSTON-PURINA, LITTLE CAHABA CREEK 177.0
BIG BLACK CREEK 171.5
PROPOSED UPPER CAHABA WWTP 168.5
STINKING CREEK 166.0
HOGPEN BRANCH 160.5
PROPOSED OVERTON WWTP 158.5
WATER SUPPLY INTAKE 149.5
LITTLE CAHABA RIVER 147.5
DIVERSION DAM 147.0
LITTLE SHADES CREEK 142.0
BLACK CR.
ACTON CREEK
PROP. CAHABA WWTP 138.5
PALSTON CREEK 135.0
BUCK CREEK 130.5
TRUSSVILLE
LEEDS
MT. BROOK
MOUNTAIN BROOK
VESTAVIA HILLS
HOOVER
LAKE PURDY
CAHABA RIVER
LITTLE CAHABA R.
LITTLE CAHABA
LITTLE SHADES CREEK
PATTON CREEK
BIG BLACK CREEK
LITTLE BLACK CREEK
CAHABA CREEK
JEFFERSON CO
ST. CLAIR CO
JEFFERSON CO.
SHELBY CO.
11
17
31
59
65
80
119
280
459
SCALE IN MILES
0
1
2
3

SOURCE: 7-1/2' USGS QUADRANGLES
GANNETT FLEMING CORDDRY AND CARPENTER, INC. 1977

STREAM SCHEMATIC QUAL-II
MODELING-CAHABA RIVER

AII-15-a

FIGURE AII-I

CAHABA RIVER BASIN
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TABLE AII-6

REAERATION COEFFICIENTS AND CONSTANTS FOR FLOW EQUATION - QUAL-II

Reach	Reaeration Coefficient (day^{-1})	Velocity Coefficient a	Velocity Exponent m
1	2.40	0.3	0.01
2	2.43	0.3	0.01
3	3.26	0.4	0.01
4	3.26	0.4	0.01
5	1.45	0.4	0.01
6	1.09	0.3	0.01
7	1.09	0.4	0.01
8	0.35	0.1	0.01
9	1.05	0.3	0.01
10	1.06	0.3	0.01
11	1.07	0.3	0.01
12	1.09	0.3	0.01
13	1.09	0.3	0.01

Source: Correspondence from Mr. James McIndoe, Alabama Water Improvement Commission, to Dr. Thomas Rachford, Gannett Fleming Corddry and Carpenter, Inc., November 29, 1976.

Gannett Fleming Corddry and Carpenter, Inc.

Water Supply Withdrawal

In addition to point sources of inflow to a river, QUAL-II can simulate withdrawals of water. There is one major withdrawal in the study area, namely, the Birmingham Water Works Board intake at approximately river mile 149.6. Approximately 2.0 miles downstream of the intake is the confluence of the Little Cahaba River with the Cahaba River. Another 0.5 miles downstream of the confluence, the river is impounded by a low-level dam. From this diversion dam to the water supply intake, the river flows slowly upstream during low flow periods.

QUAL-II simulates steady one-dimensional flow in a river and cannot accurately model the unusual hydraulics in the vicinity of the water supply withdrawal. Therefore, the computational elements in the reaches including the intake, the Little Cahaba River, and the diversion dam were adjusted as shown in Figure AII-2. Holley used a similar approximation in his work. At low flow, virtually all the flow of the Little Cahaba River is withdrawn for water supply and there is no flow over the diversion dam. Therefore, water quality downstream of the diversion dam at low flow was essentially independent of conditions upstream of the dam and the approximation shown here was valid. For augmentation alternatives in which there was flow over the diversion dam, critical water quality was found to occur well upstream of the water supply intake and again the approximation was valid.

A second small withdrawal at the location of the diversion dam was used as a computational convenience. This allowed flows to be balanced and the pool behind the diversion dam to be accounted for.

CALIBRATION AND VERIFICATION - GFC&C WATER QUALITY MODELING

No model can be used for predictive purposes unless it has first been calibrated against one set of data and verified against at least one additional set of data. Initial estimates of values for reaction rate constants and reaeration coefficients can be varied during calibration to force a model to represent the data. These variations must be realistic if the model is to serve its purpose of representing a real system. Once this first set of data has been fit by the model, the next step is verification of the model. The water quality predicted by the model using point source inputs and flow conditions given by a second set of data is compared to the in-stream water quality data. During verification, no changes are made with any of the rate constants or other parameters that have been determined during calibration. If the model's results compare favorably with the water quality shown in the data, the model is said to be verified.

AWIC's 1972 water quality survey data for August 21 to September 8 was obtained from EPA's STORET program and utilized in the initial efforts to calibrate this model. This data set was chosen because it was the best, low flow data set available when the modeling efforts were initiated. For the calibration, flow information for the Cahaba River and its tributaries were derived from the 303(e) plan, Holley's work, and the Lockheed study. Treatment plant flows were obtained from the Birmingham 201 Wastewater Facilities Plan, when this data was not available in the AWIC survey. Concentrations of dissolved oxygen, BOD, ammonia, nitrite, and nitrate discharged from treatment plants were obtained from data in the 201 report, NPDES permit information, and judgment based on the performance of similar

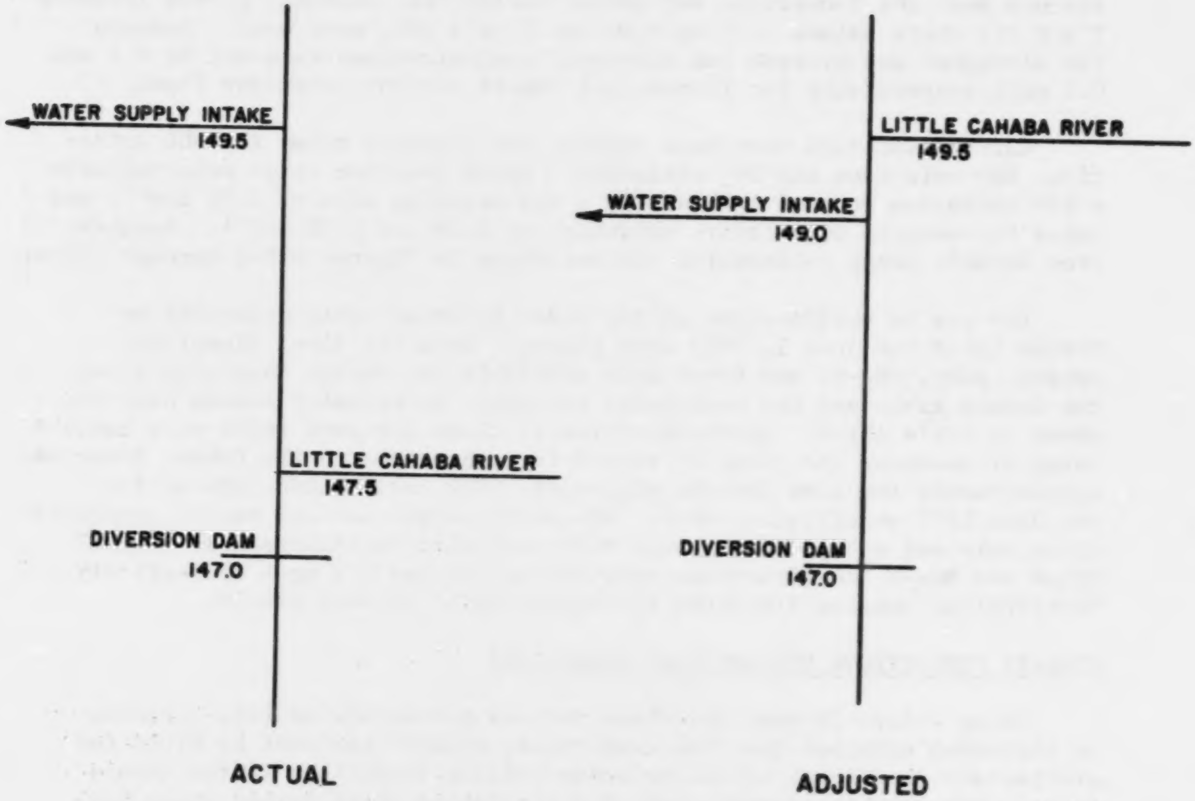
WATER SUPPLY INTAKE
149.5
LITTLE CAHABA RIVER
147.5
DIVERSION DAM
147.0
ACTUAL
LITTLE CAHABA RIVER
149.5
WATER SUPPLY INTAKE
149.0
DIVERSION DAM
147.0
ADJUSTED

FIGURE AII-2

QUAL-II ADJUSTMENTS
AT WATER SUPPLY
INTAKE-CAHABA RIVER

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wastewater treatment plants. Table AII-7 gives the point source flows and water quality characteristics used in the calibration. BOD_5 and dissolved oxygen (DO) concentrations in the incremental runoff and tributaries' flows were set at 2 mg/l and 7 mg/l, respectively, except in the more urbanized reaches near the Trussville and Cahaba wastewater treatment plants (reaches 2 and 11) where values of 5 mg/l DO and 3 mg/l BOD_5 were used. Ammonia (as nitrogen) and nitrate (as nitrogen) concentrations were set at 0.2 and 0.3 mg/l respectively for incremental runoff and for tributary flows.

Calibration runs were made varying the reaction rates for BOD oxidation, NH_3 oxidation and NO_2 oxidation. Final reaction rates selected were a BOD oxidation rate of 0.25 day^{-1}, a BOD settling rate of 0.05 day^{-1}, and rates for ammonia and nitrite oxidation of 0.35 and 1.75 day^{-1}. Results from GFC&C's final calibration run are shown in Figures AII-3 through AII-6.

For use in verification of the model by GFC&C, data collected by Barton Labs* for June 1, 1977 were chosen. Data for flow, dissolved oxygen, BOD_5, NH_3-N, and NO_3-N were available for twelve locations along the Cahaba River and for most point sources. These point source data are shown in Table AII-8. Incremental runoff flows for each reach were calculated by assuming the ratio of runoff to stream flow in the Cahaba River was approximately the same for the Aug.-Sept. 1972 calibration data as for the June 1977 verification data. Dissolved oxygen and BOD runoff concentrations were set at the same values that were used in calibration. Runoff NH_3-N and NO_3-N concentrations were set at 0.1 and 0.5 mg/l respectively. Verification results are shown in Figures AII-7 through AII-10.

QUAL-II PREDICTIONS FOR LOW FLOW CONDITIONS

Using 7-day, 10-year low flows derived previously in this appendix to represent critical low flow conditions, QUAL-II was used by GFC&C for preliminary assessment of future water quality conditions in the Cahaba River. Required treatment levels for the Cahaba plant during these low flow conditions were determined by EPA for the new NPDES permit and for 1983 and 2000 conditions, using the refined version of the model. (This EPA modeling effort is described later in this appendix.)

For the GFC&C modeling effort, projections of wastewater flows which are shown in Table III-5 of Chapter III for the year 2000 were input to the model together with the same runoff loadings, reaction rates, and reaeration coefficients that were used in the calibration and verification. Tributaries that are not subjected to major wasteloads were assumed to have the same water quality characteristics as the incremental inflows. Simulation of the Little Cahaba River to determine treatment requirements at the Leeds plant is described separately in this section of Appendix II.

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*Jefferson County Commission, Barton Laboratory, "208 Study Water Quality Data", 1977.

TABLE AII-7

CHARACTERISTICS OF TRIBUTARY FLOWS AND WASTEWATER DISCHARGES - QUAL-II CALIBRATION[1]

Source	Flow (cfs)	DO (mg/1)	Temperature (°F)	BOD_5 (mg/1)	NH_3-N (mg/1)	NO_2^--N (mg/1)	NO_3^--N (mg/1)
Trussville WWTP	0.9	2.0	77.0	40.0	2.0	0.4	13.0
Pinchgut Creek	0.6	7.0	77.0	2.0	0.2	0.0	0.3
Gold-Kist and Little Cahaba Creek[1]	3.0	2.0	77.0	10.0	1.0	0.2	2.0
Big Black Creek	3.9	7.0	77.0	2.0	0.2	0.0	0.3
Stinking Creek	1.1	7.0	77.0	2.0	0.2	0.0	0.3
Hogpen Branch	0.7	7.0	77.0	2.0	0.2	0.0	0.3
Little Cahaba River	59.0	7.5	77.0	3.0	0.1	0.0	0.3
Water Supply Intake	-71.0	-	-	-	-	-	-
Diversion Dam	-0.5	-	-	-	-	-	-
Little Shades Creek	1.5	7.0	77.0	2.0	0.2	0.0	0.3
Acton Creek	0.6	7.0	77.0	2.0	0.2	0.0	0.3
Cahaba WWTP	1.6	3.0	77.0	10.0	5.0	0.5	10.0

TABLE AII-7 (Cont'd.)

CHARACTERISTICS OF TRIBUTARY FLOWS AND WASTEWATER DISCHARGES - QUAL-II CALIBRATION[1]

Source	Flow (cfs)	DO (mg/1)	Temperature (°F)	BOD_5 (mg/1)	NH_3-N (mg/1)	NO_2-N (mg/1)	NO_3-N (mg/1)
Patton Creek WWTP and Patton Creek[1]	6.0	4.0	77.0	20.0	5.0	0.2	0.5
Buck Creek	20.0	7.0	77.0	2.0	0.2	0.0	0.3

---

(1) These are values at the confluence with the Cahaba River.

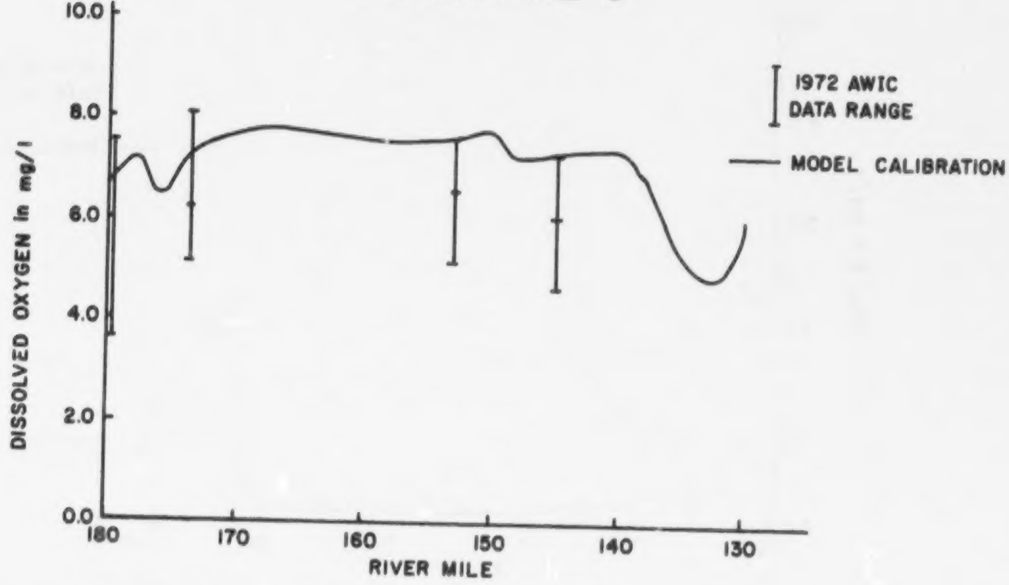
Sources: U.S.E.P.A. STORET System

Black, Crow and Eidsness, Inc., Birmingham Metropolitan Area Wastewater Facilities Plan, August, 1975.

White, J. and Johnson, B. C., Black Warrior and Cahaba River Basins Model Project, Lockhead Missiles and Space Company, Inc., 1974.

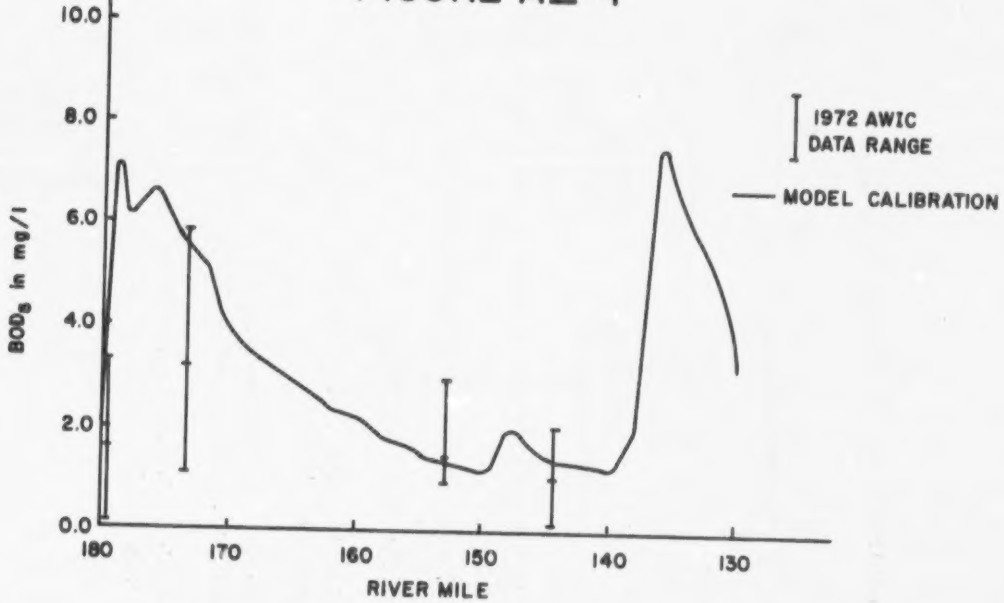
Alabama Water Improvement Commission, Water Quality Management Plan: Cahaba River Basin, July, 1974.

FIGURE AII-3



CALIBRATION WITH 1972 AWIC DATA - DISSOLVED OXYGEN

FIGURE AII-4

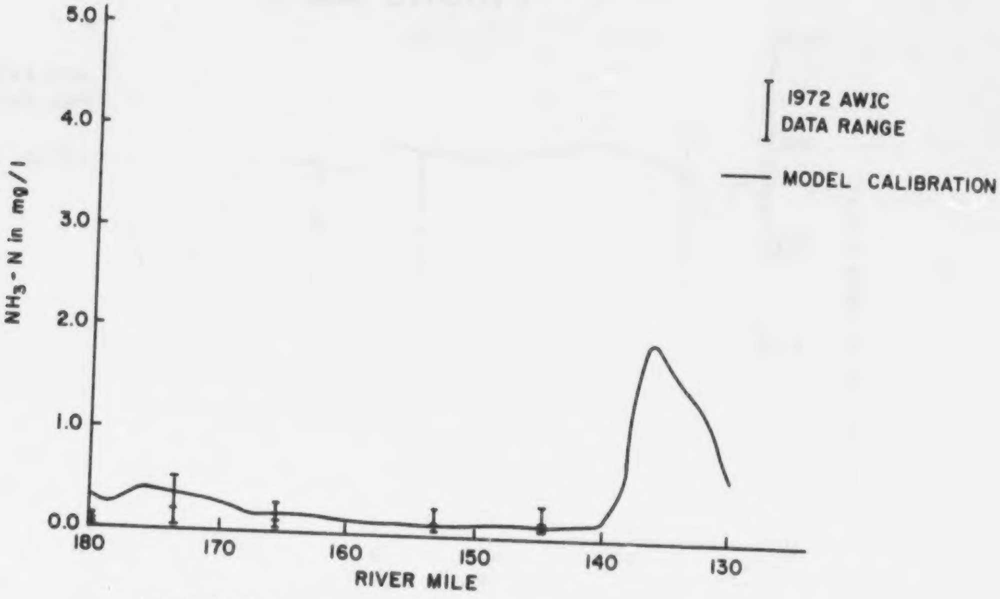


CALIBRATION WITH 1972 AWIC DATA - BOD_5

SOURCE: GANNETT FLEMING CORDDRY AND CARPENTER, INC.

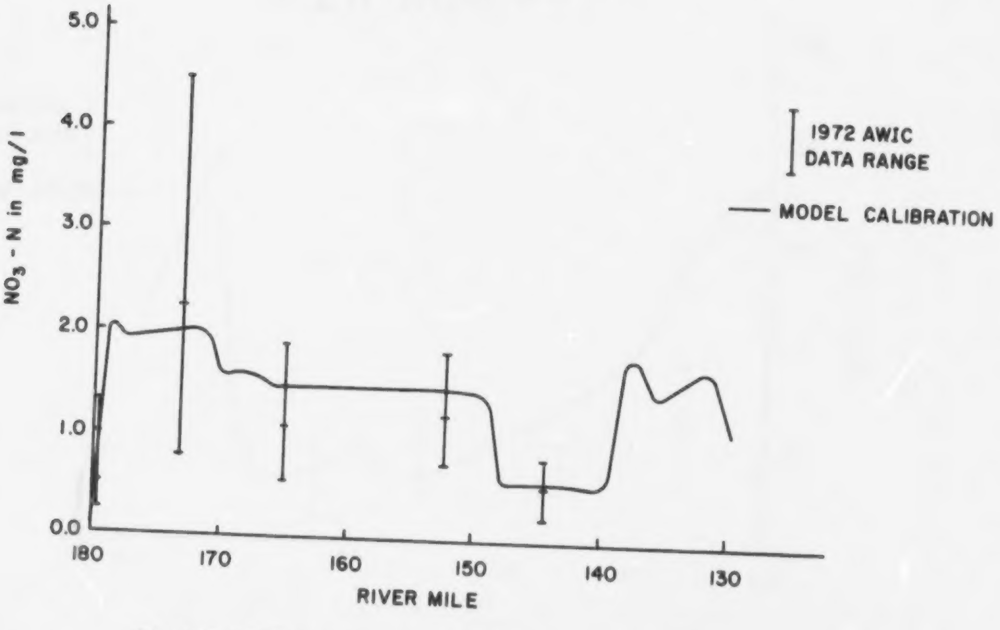
AII-20-a

FIGURE AII-5



CALIBRATION WITH 1972 AWIC DATA - AMMONIA

FIGURE AII-6



CALIBRATION WITH 1972 AWIC DATA - NITRATE

SOURCE: GANNETT FLEMING CORDDRY AND CARPENTER INC.

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TABLE AII-8

CHARACTERISTICS OF TRIBUTARY FLOWS AND WASTEWATER DISCHARGES - QUAL-II VERIFICATION WITH JUNE, 1977 BARTON LAB DATA

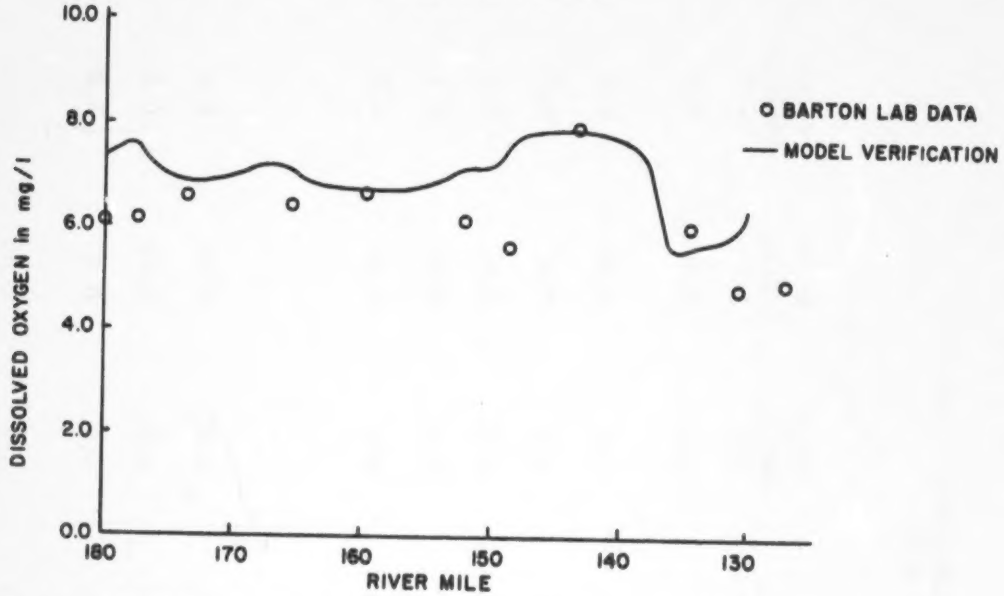
SOURCE	FLOW (cfs)	DO (mg/1)	TEMPERATURE (°F)	BOD_5 (mg/1)	NH_3-N (mg/1)	NO_2-N (mg/1)	NO_3-N (mg/1)
Trussville WWTP	1.1	7.9	70.	1.2	0.02	1.1	10.0
Pinchgut Creek	2.8	8.0	72.	2.1	0.02	0.04	0.4
Gold-Kist and Little Cahaba Creek[1]	7.1	6.5	75.	18.0	7.8	0.01	0.1
Big Black Creek	2.6	5.3	74.	1.6	0.2	0.03	0.3
Stinking Creek	1.5	5.1	75.	3.6	0.02	0.01	0.1
Hogpen Branch[2]	1.0	7.0	75.	2.0	0.02	0.01	0.1
Little Cahaba River	46.0	8.2	66.	1.1	0.1	0.02	0.2
Water Supply Intake	-71.0	-	-	-	-	-	-
Diversion Dam	-0.8	-	-	-	-	-	-
Little Shades Creek	1.0	7.0	73.	3.4	0.02	0.01	0.1
Acton Creek[2]	0.8	7.0	73.	2.0	0.02	0.01	0.1
Cahaba WWTP	2.3	6.1	73.	3.7	4.6	0.3	3.0
Patton Creek WWTP and Patton Creek[1]	7.0	2.2	77.	7.8	2.3	0.05	0.5
Buck Creek	23.0	6.4	78.	2.8	0.02	0.04	0.4

(1) These are values at the confluence with the Cahaba River.

(2) These are estimated values based on other data shown here and on the calibration data.

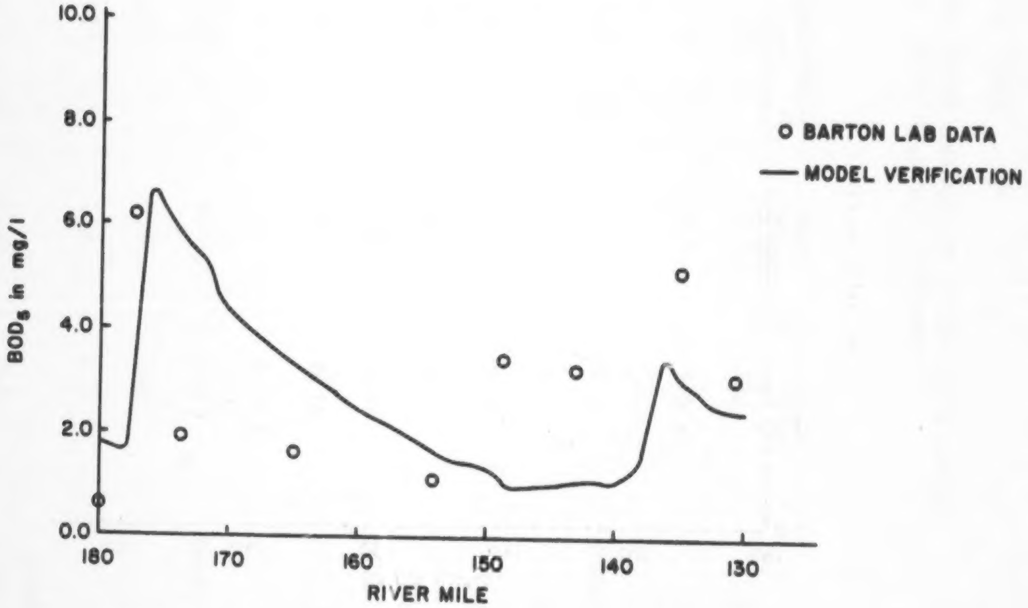
Source: Jefferson County Commission, Barton Laboratory, "208 Study Water Quality Data", 1977.

FIGURE AII-7



VERIFICATION WITH JUNE, 1977 BARTON LAB DATA - DISSOLVED OXYGEN

FIGURE AII-8



VERIFICATION WITH JUNE, 1977 BARTON LAB DATA - BOD_5

SOURCE: GANNETT FLEMING CORDDRY AND CARPENTER INC.

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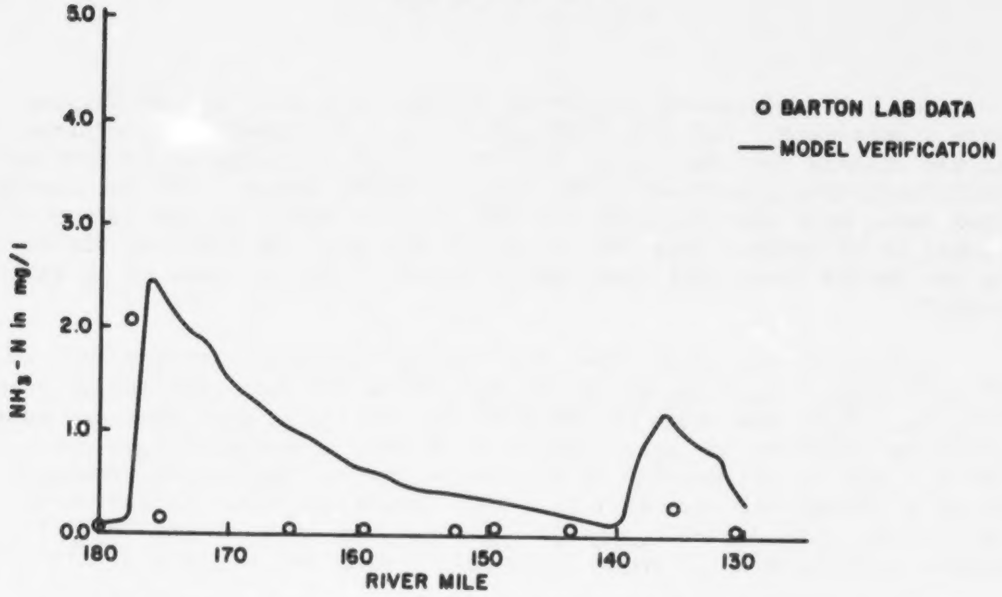
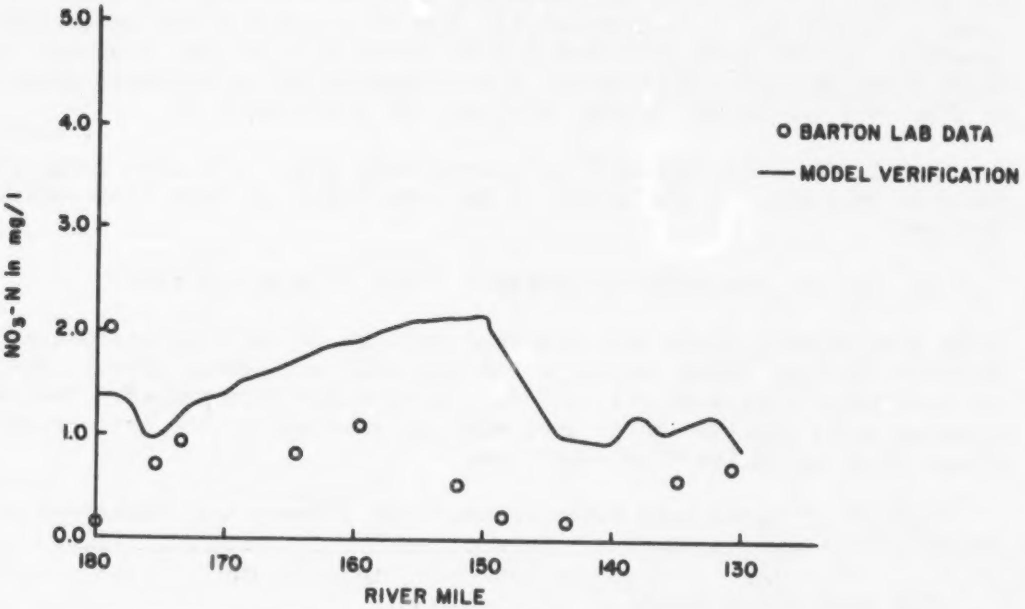
FIGURE AII-9



VERIFICATION WITH JUNE, 1977 BARTON LAB DATA - AMMONIA

FIGURE AII-10



VERIFICATION WITH JUNE, 1977 BARTON LAB DATA - NITRATE

SOURCE: GANNETT FLEMING CORDDRY AND CARPENTER INC.

The basic wastewater treatment alternatives described in Chapter III were simulated for the year 2000 with various treatment plant efficiencies. It was assumed that the future Gold-Kist plant discharge would have the characteristics specified in the existing NPDES permit. For the configuration shown here that included the continued operation of the Patton Creek plant, it is assumed that the plant effluent would be directly discharged to the Cahaba River just upstream of Patton Creek, by means of an extended outfall.

Results of the simulations that assume treatment giving 6 mg/l DO, 30 mg/l BOD_5, 5 mg/l NH_3-N, and 10 mg/l NO_3-N for each existing or proposed treatment plant are shown in Table AII-9. It can be seen that secondary treatment alone in the year 2000 will not keep dissolved oxygen concentrations above 5 mg/l in all reaches of the Cahaba River. Results of simulation done by GFC&C using more stringent treatment levels are shown in Tables AII-10 and AII-11. The QUAL-II printout corresponding to the Leeds-Trussville-Cahaba configuration shown in Table AII-10 is given as Table AII-12.

FLOW AUGMENTATION ALTERNATIVES

Lake Purdy

A possible way to improve water quality conditions along the Cahaba River below the diversion dam is to augment the river's flow by increasing the storage of Lake Purdy and releasing more water during low flow. A range of quantities of augmented flow were combined with the wastewater treatment alternatives and these system configurations were evaluated by GFC&C using QUAL-II. Incremental flow augmentations considered, given here as flow over the diversion dam, included the following:

1) 11 cfs, the estimated additional safe yield from Lake Purdy which would be available if the height of the Lake Purdy dam were increased by 10 feet.*

2) 21 cfs, the estimated natural 7-day, 10-year low flow.

These flow augmentations were analyzed for each of the five wastewater treatment alternatives using the projected year 2000 wastewater flows. Runoff and tributary flows were set at 7-day, 10-year low flow values. The corresponding water quality inputs used were the same as for the evaluation of alternatives under low flow conditions.

Results of these Lake Purdy augmentation schemes are summarized in Tables AII-13 and AII-14.

Big Black Creek Basin

Three proposed reservoirs within the Big Black Creek Basin could provide flow augmentation downstream of the creek's confluence with the Cahaba River.

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*See the hydrology discussion in this section of Appendix II.

TABLE AII-9

QUAL-II SIMULATIONS FOR THE CAHABA RIVER
EXISTING 7-DAY, 10-YEAR LOW FLOW

	Effluent D.O. (mg/1)	Effluent BOD5 (mg/1)	Effluent NH_3-N (mg/1)	Effluent NO_3-N (mg/1)	Min. in-stream D.O. below WWTP (mg/1)	River mile of min. D.O.
OVERTON - CAHABA						
Overton	6.0	30.0	5.0	10.0	4.2	155
Cahaba	6.0	30.0	5.0	10.0	<1.0	133
CAHABA						
Cahaba	6.0	30.0	5.0	10.0	<1.0	133
LEEDS - TRUSSVILLE - CAHABA						
Leeds						
Trussville	6.0	30.0	5.0	10.0	5.7	173
Cahaba	6.0	30.0	5.0	10.0	<1.0	133
TRUSSVILLE - CAHABA						
Trussville	6.0	30.0	5.0	10.0	5.7	173
Cahaba	6.0	30.0	5.0	10.0	<1.0	133
UPPER CAHABA - CAHABA						
Upper Cahaba	6.0	30.0	5.0	10.0	4.6	158
Cahaba	6.0	30.0	5.0	10.0	<1.0	133

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-10

QUAL-II SIMULATIONS FOR THE CAHABA RIVER EXISTING 7-DAY, 10-YEAR LOW FLOW

	Effluent D.O. (mg/1)	Effluent BOD_5 (mg/1)	Effluent NH_3-N (mg/1)	Effluent NO_3-N (mg/1)	Min. in-stream D.O. below WWTP (mg/1)	River mile of min. D.O.
OVERTON - CAHABA						
Overton	6.0	20.0	2.0	13.0	5.4	155
Cahaba *	7.0	8.0	0.5	13.0	5.1	133
CAHABA						
Cahaba *	7.0	8.0	0.5	13.0	5.0	133
LEEDS - TRUSSVILLE - CAHABA						
Leeds						
Trussville	6.0	30.0	5.0	10.0	5.7	173
Cahaba*	7.0	8.0	0.5	13.0	5.0	133
TRUSSVILLE - CAHABA						
Trussville	6.0	10.0	2.0	13.0	6.3	173
Cahaba *	7.0	8.0	0.5	13.0	5.0	133
UPPER CAHABA - CAHABA						
Upper Cahaba	6.0	15.0	2.0	13.0	5.8	158
Cahaba *	7.0	8.0	0.5	13.0	5.0	133
LEEDS - TRUSSVILLE - CAHABA - PATTON CREEK						
Leeds						
Trussville	6.0	30.0	5.0	10.0	5.7	173
Cahaba *	7.0	8.0	0.5	13.0	5.1	132
Patton Creek*	7.0	8.0	0.5	13.0	5.1	132

Source: Gannett Fleming Corddry and Carpenter, Inc.

*Determined by EPA, Region IV

TABLE AII-11

QUAL-II SIMULATIONS FOR THE CAHABA RIVER
EXISTING 7-DAY, 10-YEAR LOW FLOW

	Effluent D.O. (mg/1)	Effluent BOD_5 (mg/1)	Effluent NH_3-N (mg/1)	Effluent NO_3-N (mg/1)	Min. in-stream D.O. below WWTP (mg/1)	River mile of min. D.O.
OVERTON - CAHABA						
Overton	6.0	15.0	2.0	13.0	>5	155
Cahaba	6.0	4.0	2.0	13.0	>5	133
CAHABA						
Cahaba	6.0	4.0	2.0	13.0	>5	134
LEEDS - TRUSSVILLE - CAHABA						
Leeds						
Trussville	6.0	30.0	5.0	10.0	>5	173
Cahaba	6.0	4.0	2.0	13.0	>5	134
TRUSSVILLE - CAHABA						
Trussville	6.0	30.0	5.0	10.0	>5	173
Cahaba	6.0	4.0	2.0	13.0	>5	134
UPPER CAHABA - CAHABA						
Upper Cahaba	6.0	15.0	2.0	13.0	>5	158
Cahaba	6.0	4.0	2.0	13.0	>5	133

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-12 - SAMPLE QUAL-II PRINTOUT

```
                 *    *    *    *    *    *    F I N A L    R E P O R T    *    *    *    *        *

                                   REACH NO.  1.0   ABOVE TRUSSVILLE STP
                                   RIVER MILES  181.0  TO  180.5

 1.  H Y D R A U L I C   P A R A M E T E R   V A L U E S     *     *     *     *     *     *     *

          PARAMETER           HEAD OF REACH         END OF REACH     MAXIMUM      MINIMUM      AVERAGE

       FLOW (CFS)        =        1.200                1.200          1.200        1.200        1.200
       VELOCITY (FPS)    =        0.301                0.301          0.301        0.301        0.301
       DEPTH (FT)        =        3.937                3.937          3.937        3.937        3.937

 2.  W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S     *     *     *     *     *     *

    ELEM  1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20

   DO  7.19
  BOD  1.94
 ORGN  0.0
  NH3  0.00
  NO2  0.00
  NO3  0.01

 * NOTE:  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

 3.  A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S      *     *     *     *

      DECAY RATES (1/DAY)          SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE    CHLOR A/ALGAE
                                                                                                  (1/DAY)         RATIO (UG/MG)

        K1BOD =    0.25              BOD    =    0.05              BOD = 0.0                   K2 =    2.400     RATIO =    0.0
        KNH3  =    0.35              ALGAE  =    0.0               NH3 = 0.0
        KNO2  =    1.75                                            PO4 = 0.0
        KCOLI =    0.0
        KRON  =    0.0
        KNH2  =    0.0
```

TABLE AII-12 (Cont'd)

```
                  *     *     *     *     *     *     F I N A L   R E P O R T   *     *     *     *     *     *

                                        REACH NO.  2.0   TRUSSVILLE-L CAH CR
                                        RIVER MILES  180.5  TO  177.0

1.  H Y D R A U L I C   P A R A M E T E R   V A L U E S      *     *     *     *     *     *     *

          PARAMETER            HEAD OF REACH        END OF REACH      MAXIMUM      MINIMUM      AVERAGE

        FLOW (CFS)        =        3.129               3.720            3.720        3.129        3.574
        VELOCITY (FPS)    =        0.303               0.304            0.304        0.303        0.304
        DEPTH (FT)        =        3.975               3.982            3.982        3.975        3.980

2.  W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S      *     *     *     *     *     *

     ELEM   1      2      3      4      5      6      7      8      9     10     11     12     13     14     15     16     17     18     19     20

      DO  6.37   6.39   6.36   6.35   6.36   6.37   6.40
     BOD 12.59  10.90  10.45  10.03   9.62   9.23   8.86
    ORGN  0.0    0.0    0.0    0.0    0.0    0.0    0.0
     NH3  1.18   1.01   0.97   0.92   0.87   0.83   0.80
     NO2  0.03   0.06   0.08   0.10   0.11   0.12   0.13
     NO3  7.90   6.96   6.92   6.89   6.87   6.84   6.82

* NOTE:  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

3.  A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S      *     *     *     *

       DECAY RATES (1/DAY)           SETTLING RATES (1/DAY)    BENTHOS SOURCE RATES (MG/FT/DAY)    REAERATION RATE    CHLOR A/ALGAE
                                                                                                      (1/DAY)        RATIO (UG/MG)

         K1BOD =     0.25              BOD    =    0.05               BOD = 0.0                     K2 =    2.430     RATIO =    0.0
         KNH3  =     0.35              ALGAE =     0.0                NH3 = 0.0
         KNO2  =     1.75                                             PO4 = 0.0
         KCOLI =     0.0
         KRDN  =     0.0
         KNH2 =      0.0
```

TABLE AII-12 (Cont'd)

```
            *     *     *     *     *     *    F I N A L   R E P O R T    *     *     *     *     *     *

                                             REACH NO.  3.0   L CAH CR-B BLACK CR
                                             RIVER MILES  177.0  TO  171.5

1. H Y D R A U L I C  P A R A M E T E R   V A L U E S      *      *      *      *      *      *      *

          PARAMETER             HEAD OF REACH        END OF REACH      MAXIMUM      MINIMUM      AVERAGE

        FLOW (CFS)         =        6.277                6.550          6.550        6.277        6.414
        VELOCITY (FPS)     =        0.407                0.408          0.408        0.407        0.408
        DEPTH (FT)         =        1.660                1.661          1.661        1.660        1.661

2. W A T E R  Q U A L I T Y  P A R A M E T E R   V A L U E S     *      *      *      *      *      *

   ELEM  1      2      3      4      5      6      7      8      9     10     11     12     13     14     15     16     17     18     19     20

   DO  6.49   6.22   6.02   5.88   5.77   5.70   5.66   5.64   5.64   5.65   5.67
  BOD 11.03  10.70  10.38  10.07   9.77   9.48   9.20   8.92   8.66   8.40   8.15
 ORGN  0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
  NH3  4.37   4.21   4.06   3.92   3.78   3.64   3.51   3.39   3.27   3.15   3.04
  NO2  0.19   0.27   0.35   0.41   0.46   0.49   0.52   0.54   0.55   0.56   0.57
  NO3  4.27   4.30   4.34   4.39   4.45   4.51   4.58   4.65   4.72   4.80   4.87

* NCTE*  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

3. A V E R A G E  V A L U E S  O F  R E A C H  C O E F F I C I E N T S      *      *      *      *

    DECAY RATES (1/DAY)         SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE    CHLOR A/ALGAE
                                                                                               (1/DAY)         RATIO (UG/MG)

      K1BOD =    0.25             BOD    =    0.05              BOD = 0.0                  K2 =    3.260     RATIO =    0.0
      KNH3  =    0.35             ALGAE  =    0.0               NH3 = 0.0
      KNO2  =    1.75                                           PO4 = 0.0
      KCOLI =    0.0
      KRDN  =    0.0
      KNH2 =     0.0
```

TABLE AII-12 (Cont'd)

```
             *     *     *     *     *     *     F I N A L   R E P O R T     *     *     *     *     *     *

                                          REACH NO.  4.0   B BLACK CR-STINK CR
                                          RIVER MILES  171.5  TO  166.0


1.  H Y D R A U L I C   P A R A M E T E R   V A L U E S     *     *     *     *     *     *     *

          PARAMETER             HEAD OF REACH        END OF REACH      MAXIMUM      MINIMUM      AVERAGE

       FLOW (CFS)          =        9.027                9.300           9.300        9.027        9.164
       VELOCITY (FPS)      =        0.409                0.409           0.409        0.409        0.409
       DEPTH (FT)          =        1.656                1.657           1.657        1.656        1.656

2.  W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S     *     *     *     *     *     *

   ELEM  1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20

    DO  6.10  6.17  6.23  6.29  6.35  6.41  6.46  6.51  6.56  6.61  6.66
   BOD  6.31  6.14  5.96  5.79  5.63  5.47  5.31  5.16  5.02  4.88  4.74
  ORGN  0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
   NH3  2.20  2.12  2.05  1.98  1.91  1.84  1.78  1.72  1.66  1.60  1.55
   NO2  0.42  0.42  0.41  0.41  0.40  0.40  0.39  0.38  0.38  0.37  0.36
   NO3  3.68  3.73  3.79  3.85  3.91  3.96  4.01  4.07  4.12  4.16  4.21

* NOTE'  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)


3.  A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S     *     *     *     *


      DECAY RATES (1/DAY)          SETTLING RATES (1/DAY)    BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE    CHLOR A/ALGAE
                                                                                                  (1/DAY)          RATIO (UG/MG)

        K1BOD =    0.25              BOD    =    0.05               BOD = 0.0                K2 =    3.260     RATIO =    0.0
        KNH3  =    0.35              ALGAE  =    0.0                NH3 = 0.0
        KNO2  =    1.75                                             PO4 = 0.0
        KCOLI =    0.0
        KRDN  =    0.0
        KNH2 =     0.0
```

TABLE AII-12 (Cont'd)

```
           *     *     *     *     *     *    F I N A L   R E P O R T   *     *     *     *     *     *

                                              REACH NO.  5.0   STINK CR-HOGPEN BR
                                              RIVER MILES  166.0  TO  160.5

 1.  H Y D R A U L I C   P A R A M E T E R   V A L U E S     *     *     *     *     *     *     *

          PARAMETER           HEAD OF REACH      END OF REACH     MAXIMUM      MINIMUM      AVERAGE

        FLOW (CFS)       =       9.967              10.240         10.240        9.967       10.104
        VELOCITY (FPS)   =       0.409               0.409          0.409        0.409        0.409
        DEPTH (FT)       =       2.231               2.231          2.231        2.231        2.231

 2.  W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S     *     *     *     *     *     *

    ELEM  1     2     3     4     5     6     7     8     9     10    11    12    13    14    15    16    17    18    19    20

    DO   6.65  6.53  6.43  6.35  6.28  6.23  6.20  6.17  6.16  6.15  6.15
    BOD  4.44  4.31  4.19  4.08  3.96  3.85  3.75  3.64  3.54  3.44  3.35
   ORGN  0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
    NH3  1.41  1.36  1.32  1.27  1.23  1.19  1.15  1.11  1.07  1.03  1.00
    NO2  0.33  0.32  0.31  0.30  0.29  0.28  0.28  0.27  0.26  0.25  0.24
    NO3  4.00  4.04  4.09  4.12  4.16  4.20  4.23  4.27  4.30  4.33  4.36
 * NOTE'  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

 3.  A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S     *     *     *     *

       DECAY RATES (1/DAY)          SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE   CHLOR A/ALGAE
                                                                                                   (1/DAY)        RATIO (UG/MG)

         K1BOD =    0.25              BOD   =    0.05
         KNH3  =    0.35              ALGAE =    0.0                 BOD = 0.0               K2 =    1.450     RATIO =    0.0
         KNO2  =    1.75                                             NH3 = 0.0
         KCOLI =    0.0                                              PO4 = 0.0
         KPON  =    0.0
         KNH2  =    0.0
```

TABLE AII-12 (Cont'd)

```
           *   *   *   *   *   *    F I N A L   R E P O R T    *   *   *   *   *   *

                                  REACH NO.  6.0   HOGPEN BR-GUMSUCK BR
                                  RIVER MILES  160.5  TO  154.0

1. H Y D R A U L I C   P A R A M E T E R   V A L U E S     *     *     *     *     *     *     *

      PARAMETER            HEAD OF REACH       END OF REACH     MAXIMUM     MINIMUM     AVERAGE

    FLOW (CFS)        =       10.623             10.900          10.900      10.623      10.762
    VELOCITY (FPS)    =        0.307              0.307           0.307       0.307       0.307
    DEPTH (FT)        =        1.259              1.260           1.260       1.259       1.260

2. W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S     *     *     *     *     *     *

   ELEM  1     2     3     4     5     6     7     8     9     10    11    12    13    14    15    16    17    18    19    20

  DO   6.17  6.12  6.09  6.08  6.07  6.08  6.09  6.11  6.14  6.17  6.21  6.24  6.29
  BOD  3.20  3.09  2.98  2.87  2.77  2.67  2.58  2.48  2.40  2.31  2.23  2.15  2.08
  ORGN 0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
  NH3  0.94  0.89  0.86  0.82  0.78  0.75  0.72  0.69  0.66  0.63  0.60  0.57  0.55
  NO2  0.23  0.22  0.21  0.20  0.19  0.18  0.18  0.17  0.16  0.16  0.15  0.14  0.14
  NO3  4.26  4.29  4.33  4.37  4.40  4.43  4.46  4.49  4.52  4.54  4.56  4.59  4.61

* NOTE'  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

3. A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S     *     *     *     *

    DECAY RATES (1/DAY)          SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE   CHLOR A/ALGAE
                                                                                               (1/DAY)        RATIO (UG/MG)
     K1BOD =    0.25                 BOD    =    0.05
     KNH3  =    0.35                 ALGAE  =    0.0                 BOD = 0.0
     KNO2  =    1.75                                                 NH3 = 0.0             K2 =   1.090     RATIO =    0.0
     KCOLI =    0.0                                                  PO4 = 0.0
     KRDN  =    0.0
     KNH2  =    0.0
```

TABLE AII-12 (Cont'd)

```
          *     *     *     *     *     *     F I N A L   R E P O R T    *     *     *     *     *     *

                                               REACH NO.  7.0   GUMSUCK-BWWB INTAKE
                                               RIVER MILES  154.0  TO  149.0


1. H Y D R A U L I C  P A R A M E T E R  V A L U E S     *     *     *     *     *     *     *

          PARAMETER             HEAD OF REACH       END OF REACH      MAXIMUM      MINIMUM      AVERAGE

       FLOW (CFS)         =        10.930              72.500          72.500       10.930       17.195
       VELOCITY (FPS)     =         0.410               0.418           0.418        0.410        0.412
       DEPTH (FT)         =         1.137               1.159           1.159        1.137        1.142

2. W A T E R  Q U A L I T Y  P A R A M E T E R  V A L U E S     *     *     *     *     *     *

   ELEM  1      2      3      4      5      6      7      8      9     10     11     12     13     14     15     16     17     18     19     20

    DO  6.35   6.43   6.51   6.58   6.64   6.70   6.76   6.82   6.87   7.41
   BOD  2.01   1.96   1.91   1.86   1.81   1.76   1.72   1.67   1.63   2.75
  ORGN  0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0    0.0
   NH3  0.53   0.51   0.49   0.48   0.46   0.45   0.43   0.42   0.40   0.14
   NO2  0.13   0.13   0.12   0.12   0.11   0.11   0.11   0.10   0.10   0.02
   NO3  4.62   4.63   4.64   4.65   4.65   4.66   4.66   4.67   4.67   0.98
* NOTE!  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)


3. A V E R A G E  V A L U E S  O F  R E A C H  C O E F F I C I E N T S     *     *     *     *


      DECAY RATES (1/DAY)        SETTLING RATES (1/DAY)    BENTHOS SOURCE RATES (MG/FT/DAY)    REAERATION RATE    CHLOR A/ALGAE
                                                                                                 (1/DAY)         RATIO (UG/MG)

        K1BOD =    0.25              BOD    =    0.05              BOD = 0.0                 K2 =    1.460      RATIO =    0.0
        KNH3  =    0.35              ALGAE  =    0.0               NH3 = 0.0
        KNO2  =    1.75                                            PO4 = 0.0
        KCOLI =    0.0
        KRON  =    0.0
        KNH2  =    0.0
```

TABLE AII-12 (Cont'd)

```
        *     *     *     *     *     *     F I N A L   R E P O R T     *     *     *     *     *     *

                                         REACH NO.  8.0   BWWB INTAKE- DAM
                                         RIVER MILES  149.0  TO  147.0

1. H Y D R A U L I C   P A R A M E T E R   V A L U E S     *     *     *     *     *     *     *

        PARAMETER          HEAD OF REACH       END OF REACH      MAXIMUM      MINIMUM      AVERAGE

     FLOW (CFS)         =      0.325              0.400           0.400        0.325        0.362
     VELOCITY (FPS)     =      0.099              0.099           0.099        0.099        0.099
     DEPTH (FT)         =      1.483              1.486           1.486        1.483        1.485

2. W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S     *     *     *     *     *     *

     ELEM  1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20

     DO  7.39  7.18  7.03  6.92
    BOD  2.71  2.40  2.14  1.92
   ORGN  0.0   0.0   0.0   0.0
    NH3  0.14  0.13  0.12  0.11
    NO2  0.02  0.02  0.02  0.02
    NO3  0.98  0.94  0.91  0.89

* NOTE:  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

3. A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S     *     *     *     *

     DECAY RATES (1/DAY)          SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE   CHLOR A/ALGAE
                                                                                               (1/DAY)         RATIO (UG/MG)

       K1BOD =    0.25                BOD    =    0.05              BOD - 0.0                  K2 =   0.350    RATIO =   0.0
       KNH3  =    0.35                ALGAE  =    0.0               NH3 = 0.0
       KNO2  =    1.75                                              PO4 = 0.0
       KCOLI =    0.0
       KRDN  =    0.0
       KNH2 =     0.0
```

TABLE AII-12 (Cont'd)

```
                         *    *    *    *    *    *    F I N A L   R E P O R T    *    *    *    *    *    *

                                              REACH NO.  9.0    DAM-UNNAMED TRIB
                                              RIVER MILES  147.0  TO  144.0


1.  H Y D R A U L I C   P A R A M E T E R   V A L U E S      *      *      *      *      *      *      *

          PARAMETER           HEAD OF REACH         END OF REACH       MAXIMUM       MINIMUM       AVERAGE

        FLOW (CFS)        =        0.233                 0.400            0.400         0.233         0.317
        VELOCITY (FPS)    =        0.296                 0.297            0.297         0.296         0.297
        DEPTH (FT)        =        0.307                 0.309            0.309         0.307         0.308

2.  W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S      *      *      *      *      *      *

    ELEM  1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20

     DO  6.95  7.01  7.06  7.10  7.13  7.16
    BOD  1.81  1.77  1.74  1.70  1.67  1.64
   ORGN  0.0   0.0   0.0   0.0   0.0   0.0
    NH3  0.11  0.11  0.12  0.12  0.12  0.12
    NO2  0.02  0.02  0.02  0.02  0.02  0.02
    NO3  0.85  0.78  0.73  0.70  0.66  0.64

* NOTE'  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)


3.  A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S      *      *      *      *


     DECAY RATES (1/DAY)         SETTLING RATES (1/DAY)    BENTHOS SOURCE RATES (MG/FT/DAY)    REAERATION RATE     CHLOR A/ALGAE
                                                                                                 (1/DAY)          RATIO (UG/MG)

        K1BOD =     0.25            BOD   =    0.05                BOD = 0.0                   K2 =   1.050       RATIO =    0.0
        KNH3  =     0.35            ALGAE =    0.0                 NH3 = 0.0
        KNO2  =     1.75                                           PO4 = 0.0
        KCOLI =     0.0
        KRDN  =     0.0
        KNH2 =      0.0
```

TABLE AII-12 (Cont'd)

```
                     * * * * * *   FINAL REPORT   * * * * * *

                                REACH NO. 10.0   UNNAMED-L SHADES CR
                                RIVER MILES  144.0  TO  142.0

1. HYDPAULIC PARAMETER VALUES   * * * * * * *

          PARAMETER              HEAD OF REACH     END OF REACH    MAXIMUM    MINIMUM    AVERAGE
        FLOW (CFS)        =         0.425             0.500         0.500      0.425      0.462
        VELOCITY (FPS)    =         0.297             0.298         0.298      0.297      0.298
        DEPTH (FT)        =         0.575             0.576         0.576      0.575      0.576

2. WATER QUALITY PARAMETER VALUES   * * * * * *

   ELEM  1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20

   DO   7.19  7.22  7.24  7.26
   BOD  1.60  1.57  1.53  1.50
  ORGN  0.0   0.0   0.0   0.0
   NH3  0.12  0.12  0.12  0.12
   NO2  0.02  0.02  0.02  0.02
   NO3  0.62  0.61  0.59  0.58

* NOTE'  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

3. AVERAGE VALUES OF REACH COEFFICIENTS   * * * *

    DECAY RATES (1/DAY)         SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE    CHLOR A/ALGAE
                                                                                              (1/DAY)          RATIO (UG/MG)
      K1BOD =    0.25             BOD    =    0.05
      KNH3  =    0.35             ALGAE  =    0.0            BOD = 0.0                    K2 =   1.060       RATIO =   0.0
      KNO2  =    1.75                                        NH3 = 0.0
      KCOLI =    0.0                                         PO4 = 0.0
      KRDN  =    0.0
      KNH2 =     0.0
```

TABLE AII-12 (Cont'd)

```
                        *   *   *   *   *   *   F I N A L   R E P O R T   *   *   *   *   *   *

                                                REACH NO. 11.0   L SHADES CR-CAH STP
                                                RIVER MILES  142.0  TO  138.5


1. H Y D R A U L I C   P A R A M E T E R   V A L U E S    *    *    *    *    *    *    *

        PARAMETER           HEAD OF REACH       END OF REACH      MAXIMUM      MINIMUM      AVERAGE

     FLOW (CFS)        =       1.229               1.700           1.700        1.229        1.357
     VELOCITY (FPS)    =       0.301               0.302           0.302        0.301        0.301
     DEPTH (FT)        =       0.581               0.583           0.583        0.581        0.582

2. W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S    *    *    *    *    *    *

    ELEM  1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20

    DO  7.13  7.17  7.20  7.23  7.25  7.28  7.25
   BOD  1.75  1.70  1.64  1.59  1.54  1.50  1.54
  ORGN  0.0   0.0   0.0   0.0   0.0   0.0   0.0
   NH3  0.16  0.16  0.15  0.15  0.14  0.14  0.14
   NO2  0.01  0.01  0.02  0.02  0.02  0.02  0.02
   NO3  0.42  0.42  0.42  0.42  0.42  0.42  0.41

* NOTE:  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)


3. A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S    *    *    *    *


     DECAY RATES (1/DAY)         SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE    CHLOR A/ALGAE
                                                                                                (1/DAY)        RATIO (UG/MG)

       K1BOD =    0.25               BOD   =    0.05              BOD = 0.0                  K2 =    1.070     RATIO =    0.0
       KNH3  =    0.35               ALGAE =    0.0               NH3 = 0.0
       KNO2  =    1.75                                            PO4 = 0.0
       KCOLI =    0.0
       KRDN  =    0.0
       KNH2 =     0.0
```

TABLE AII-12 (Cont'd)

```
      *    *    *    *    *    *    F I N A L   R E P O R T    *    *    *    *    *    *

                                      REACH NO. 12.0   CAH STP-PATTON CR
                                      RIVER MILES  138.5   TO  136.0

1. H Y D R A U L I C   P A R A M E T E R   V A L U E S    *    *    *    *    *    *    *

        PARAMETER             HEAD OF REACH      END OF REACH     MAXIMUM     MINIMUM     AVERAGE

     FLOW (CFS)        =         24.340            24.500         24.500      24.340      24.420
     VELOCITY (FPS)    =          0.310             0.310          0.310       0.310       0.310
     DEPTH (FT)        =          0.599             0.599          0.599       0.599       0.599

2. W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S    *    *    *    *    *    *

    ELEM  1      2      3      4      5      6    7    8    9   10   11   12   13   14   15   16   17   18   19   20

    DO   5.95   5.73   5.54   5.39   5.25
    BOD  7.40   7.13   6.88   6.63   6.39
   ORGN  0.0    0.0    0.0    0.0    0.0
    NH3  1.82   1.75   1.67   1.60   1.53
    NO2  0.04   0.09   0.14   0.17   0.19
    NO3 12.10  12.10  12.11  12.13  12.15

* NOTE'  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

3. A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S    *    *    *    *

   DECAY RATES (1/DAY)          SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE   CHLOR A/ALGAE
                                                                                              (1/DAY)         RATIO (UG/MG)
     K1BOD =   0.25               BOD   =   0.05
     KNH3  =   0.35               ALGAE =   0.0               BOD = 0.0                     K2 =   1.090      RATIO =   0.0
     KNO2  =   1.75                                           NH3 = 0.0
     KCOLI =   0.0                                            PO4 = 0.0
     KRON  =   0.0
     KNH2  =   0.0
```

TABLE AII-12 (Cont'd)

```
     *     *     *     *     *     *     F I N A L   R E P O R T     *     *     *     *     *     *

                                    REACH NO. 13.0   PATTOON CR-BELOW BUC
                                    RIVER MILES  136.0  TO  127.0

1. H Y D R A U L I C   P A R A M E T E R   V A L U E S     *     *     *     *     *     *     *

       PARAMETER          HEAD OF REACH        END OF REACH     MAXIMUM     MINIMUM     AVERAGE

     FLOW (CFS)       =      25.728              30.400         30.400      25.728      27.597
     VELOCITY (FPS)   =       0.310               0.310          0.310       0.310       0.310
     DEPTH (FT)       =       0.506               0.507          0.507       0.506       0.507

2. W A T E R   Q U A L I T Y   P A R A M E T E R   V A L U E S     *     *     *     *     *     *

   ELEM  1     2     3     4     5     6     7     8     9    10    11    12    13    14    15    16    17    18    19    20

    DO  5.15  5.08  5.03  4.99  4.98  4.97  4.98  5.00  5.02  5.06  5.10  5.41  5.46  5.52  5.57  5.63  5.69  5.76
   BOD  5.97  5.76  5.56  5.36  5.17  4.99  4.81  4.64  4.48  4.32  4.17  3.74  3.61  3.48  3.36  3.24  3.13  3.02
  ORGN  0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0
   NH3  1.41  1.35  1.29  1.24  1.18  1.13  1.08  1.04  0.99  0.95  0.91  0.78  0.75  0.72  0.69  0.66  0.63  0.60
   NO2  0.20  0.21  0.22  0.23  0.23  0.23  0.23  0.22  0.22  0.21  0.21  0.17  0.17  0.16  0.16  0.15  0.15  0.14
   NO3 11.63 11.67 11.70 11.74 11.78 11.81 11.85 11.88 11.92 11.95 11.99 10.39 10.41 10.44 10.47 10.49 10.51 10.54
* NOTE:  UNITS ARE MG/L, EXCEPT FOR FECAL COLIFORM(1000/100ML) AND CONSERVATIVE MINERALS(MG/L*10)

3. A V E R A G E   V A L U E S   O F   R E A C H   C O E F F I C I E N T S     *     *     *     *

      DECAY RATES (1/DAY)        SETTLING RATES (1/DAY)   BENTHOS SOURCE RATES (MG/FT/DAY)   REAERATION RATE   CHLOR A/ALGAE
                                                                                                 (1/DAY)       RATIO (UG/MG)

        K1BOD =    0.25            BOD    =    0.05              BOD = 0.0                   K2 =    1.090     RATIO =    0.0
        KNH3  =    0.35            ALGAE  =    0.0               NH3 = 0.0
        KNO2  =    1.75                                          PO4 = 0.0
        KCOLI =    0.0
        KRON  =    0.0
        KNH2  =    0.0
```

Source: Gannett Fleming Corddry and Carpenter, Inc.

Roesner, L.A., J.R. Monser and D.E. Evenson, Computer Program Documentation for the Stream Quality Model QUAL-II, prepared for the Environmental Protection Agency, Systems Development Branch, Washington, D.C., May, 1973.

TABLE AII-13

QUAL-II SIMULATIONS FOR THE CAHABA RIVER
EXISTING 7-DAY, 10-YEAR LOW FLOW PLUS
AUGMENTATION AVAILABLE BY RAISING LAKE PURDY DAM 10 FEET

	Effluent D.O. (mg/1)	Effluent BOD_5 (mg/1)	Effluent NH_3-N (mg/1)	Effluent NO_3-N (mg/1)	Min. in-stream D.O. below WWTP (mg/1)	River mile of min. D.O.
OVERTON - CAHABA						
Overton	6.0	15.0	2.0	13.0	5.6	154
Cahaba	6.0	8.0	2.0	13.0	5.9	133
CAHABA						
Cahaba	6.0	8.0	2.0	13.0	5.8	133
LEEDS - TRUSSVILLE - CAHABA						
Leeds						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	8.0	2.0	13.0	5.9	133
TRUSSVILLE - CAHABA						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	8.0	2.0	13.0	5.9	133
UPPER CAHABA - CAHABA						
Upper Cahaba	6.0	15.0	2.0	13.0	5.8	158
Cahaba	6.0	8.0	2.0	13.0	5.9	133

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-14

QUAL-II SIMULATIONS FOR THE CAHABA RIVER
NATURAL 7-DAY, 10-YEAR LOW FLOW

	Effluent D.O. (mg/1)	Effluent BOD5 (mg/1)	Effluent NH_3-N (mg/1)	Effluent NO_3-N (mg/1)	Min. in-stream D.O. below WWTP (mg/1)	River mile of min. D.O.
OVERTON - CAHABA						
Overton	6.0	15.0	2.0	13.0	5.8	154
Cahaba	6.0	8.0	2.0	13.0	6.4	133
CAHABA						
Cahaba	6.0	8.0	2.0	13.0	6.2	133
Cahaba	6.0	15.0	2.0	13.0	5.7	133
LEEDS - TRUSSVILLE - CAHABA						
Leeds						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	8.0	2.0	13.0	6.3	133
TRUSSVILLE - CAHABA						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	8.0	2.0	13.0	6.3	133
UPPER CAHABA - CAHABA						
Upper Cahaba	6.0	15.0	2.0	13.0	5.8	158
Cahaba	6.0	8.0	2.0	13.0	6.4	133

Source: Gannett Fleming Corddry and Carpenter, Inc.

For this analysis, it has been assumed that flow augmentation from the Big Black Creek Basin would be allowed to bypass the water supply intake and the diversion dam. QUAL-II was used to simulate the following amounts of augmentation, given as flow over the diversion dam:

1) 7 cfs, the estimated safe yield from the proposed Middle Black Creek reservoir.

2) 19 cfs, the estimated safe yield from the proposed reservoir on Big Black Creek upstream of its confluence with Middle and Little Black Creeks.

3) 41 cfs, the estimated total safe yield from the three proposed reservoirs in the Big Black Creek Basin.

As with the Lake Purdy augmentation runs, Big Black Creek augmentation was considered for each of the wastewater treatment alternatives in the year 2000. Characteristics of runoff and the other tributaries were kept at the values used in the 7-day, 10-year low flow model runs.

The effects of these flow augmentation schemes on the Cahaba River for the year 2000 are shown in Tables AII-15 through AII-17.

PRELIMINARY LITTLE CAHABA RIVER SIMULATION

The Leeds wastewater treatment plant presently discharges its effluent to the Little Cahaba River approximately eight miles upstream of Lake Purdy. The retention of the Leeds plant and continuation of this discharge to the Little Cahaba River were included in some of the wastewater disposal alternatives considered in this study. Therefore, QUAL-II simulation of the Little Cahaba River downstream of Leeds was necessary to determine future wastewater treatment requirements to meet Alabama water quality criteria.

The Little Cahaba River from the Leeds wastewater treatment plant to Lake Purdy was divided into 16 computational elements of half-mile length and three reaches, as shown in Figure AII-11. The coefficients and constants in the velocity-flow and depth-flow relations in QUAL-II were derived from information in the AWIC study, as was done for the Cahaba River modeling. Data from the 1972 AWIC water quality survey were used for preliminary calibration of the model. The BOD removal rate, ammonia oxidation rate and nitrite oxidation rate that resulted from the Cahaba River calibration were also selected for the Little Cahaba River.

The effect of the Leeds wastewater treatment plant discharge on the Little Cahaba River was then modeled using 7-day, 10-year low flows calculated from the runoff factors derived in this appendix and the year 2000 wastewater flows given in Table III-5 of Chapter III. The treatment level required at the Leeds plant to meet the dissolved oxygen criterion in the Little Cahaba River is shown in Table AII-18.

TABLE AII-15

QUAL-II SIMULATIONS FOR THE CAHABA RIVER AUGMENTATION FROM PROPOSED MIDDLE BLACK CREEK RESERVOIR

	Effluent D.O. (mg/1)	Effluent BOD5 (mg/1)	Effluent NH_3-N (mg/1)	Effluent NO_3-N (mg/1)	Min. in-stream D.O. below WWTP (mg/1)	River mile of min. D.O.
OVERTON - CAHABA						
Overton	6.0	30.0	5.0	10.0	5.3	154
Cahaba	6.0	8.0	2.0	13.0	5.6	133
Cahaba	6.0	15.0	2.0	13.0	4.9	133
CAHABA						
Cahaba	6.0	15.0	2.0	13.0	4.8	133
LEEDS - TRUSSVILLE - CAHABA						
Leeds Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	15.0	2.0	13.0	4.9	133
TRUSSVILLE - CAHABA						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	15.0	2.0	13.0	4.9	133
UPPER CAHABA - CAHABA						
Upper Cahaba	6.0	30.0	5.0	10.0	5.6	158
Cahaba	6.0	15.0	2.0	13.0	5.0	133

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-16

QUAL-II SIMULATIONS FOR THE CAHABA RIVER AUGMENTATION FROM PROPOSED BIG BLACK CREEK RESERVOIR

	Effluent D.O. (mg/1)	Effluent BOD5 (mg/1)	Effluent NH_3-N (mg/1)	Effluent NO_3-N (mg/1)	Min. in-stream D.O. below WWTP (mg/1)	River mile of min. D.O.
OVERTON - CAHABA						
Overton	6.0	30.0	5.0	10.0	6.2	154
Cahaba	6.0	15.0	2.0	13.0	5.7	133
CAHABA						
Cahaba	6.0	15.0	2.0	13.0	5.6	133
LEEDS - TRUSSVILLE - CAHABA						
Leeds						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	15.0	2.0	13.0	5.7	133
TRUSSVILLE - CAHABA						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	15.0	2.0	13.0	5.6	133
UPPER CAHABA - CAHABA						
Upper Cahaba	6.0	30.0	5.0	10.0	6.1	158
Cahaba	6.0	15.0	2.0	13.0	5.7	133

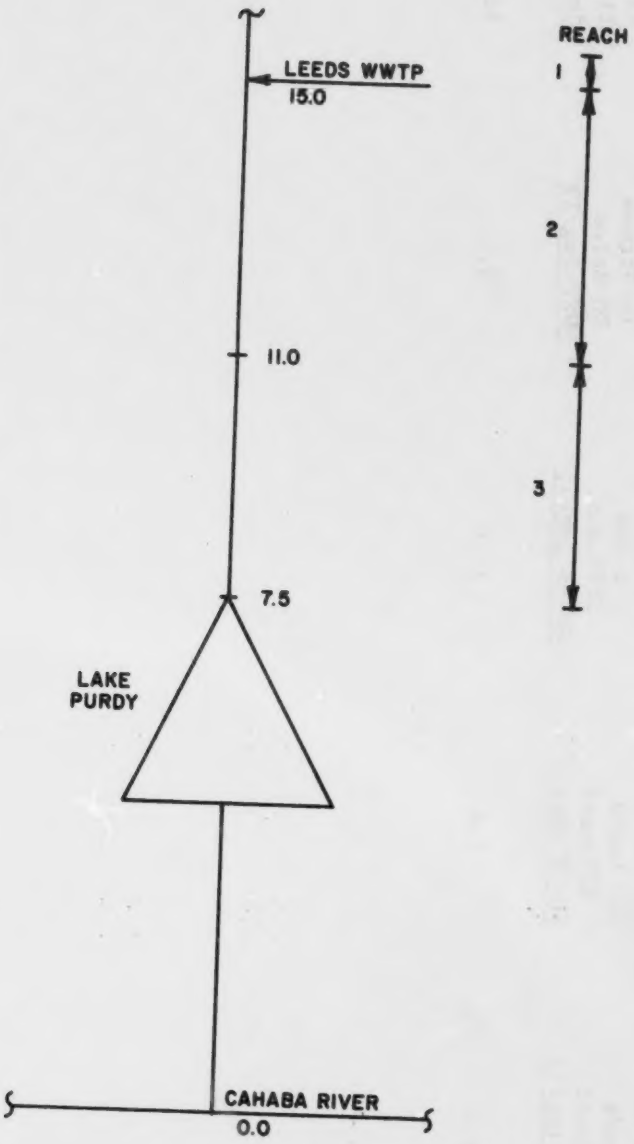
Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-17

QUAL-II SIMULATIONS FOR THE CAHABA RIVER
AUGMENTATION FROM THREE PROPOSED RESERVOIRS IN BIG BLACK CREEK BASIN

	Effluent D.O. (mg/1)	Effluent BOD_5 (mg/1)	Effluent NH_3-N (mg/1)	Effluent NO_3-N (mg/1)	Min. in-stream D.O. below WWTP (mg/1)	River mile of min. D.O.
OVERTON - CAHABA						
Overton	6.0	30.0	5.0	10.0	6.8	154
Cahaba	6.0	20.0	5.0	10.0	5.2	132
CAHABA						
Cahaba	6.0	15.0	2.0	13.0	6.2	134
LEEDS - TRUSSVILLE - CAHABA						
Leeds						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	15.0	2.0	13.0	6.4	134
TRUSSVILLE - CAHABA						
Trussville	6.0	30.0	5.0	10.0	5.7	174
Cahaba	6.0	15.0	2.0	13.0	6.3	134
UPPER CAHABA - CAHABA						
Upper Cahaba	6.0	30.0	5.0	10.0	7.0	158
Cahaba	6.0	15.0	2.0	13.0	6.5	132

Source: Gannett Fleming Corddry and Carpenter, Inc.


REACH
1
2
3
LEEDS WWTP
15.0
11.0
7.5
LAKE
PURDY
CAHABA RIVER
0.0

SOURCE: 7-1/2' USGS QUADRANGLES

GANNETT FLEMING CORDDRY AND CARPENTER, INC. 1977

STREAM SCHEMATIC QUAL-II MODELING LITTLE CAHABA RIVER

FIGURE AII-11

CAHABA RIVER BASIN
DRAFT EIS
PREPARED FOR
REGION IV U.S. ENVIRONMENTAL PROTECTION AGENCY

AII-44-a

TABLE AII-18

QUAL-II SIMULATION FOR THE LITTLE CAHABA RIVER EXISTING 7-DAY, 10-YEAR LOW FLOW

Leeds Effluent DO (mg/1)	Leeds Effluent BOD_5 (mg/1)	Leeds Effluent NH_3-N (mg/1)	Leeds Effluent NO_3-N (mg/1)	Min. In-Stream DO Below WWTP (mg/1)	River Mile of Min. DO
6.0	20.0	2.0	13.0	5.1	11.5

EPA WATER QUALITY MODELING

As discussed earlier in this section of the appendix and in Chapter III of the EIS, treatment requirements for the Cahaba WWTP for NPDES permitting purposes and for 1983 and 2000 conditions were determined by the Technical Support Branch of the EPA, Region IV. The documentation report for this EPA water quality modeling effort follows.

December 8, 1977

CAHABA RIVER MODEL DOCUMENTATION REPORT

The following is a description of the mathematical modeling effort of the Cahaba River performed by the Environmental Protection Agency, Region IV, Technical Support Branch. The format of this documentation report is as follows:

I. The purpose of the modeling effort;

II. The study area;

III. The available data;

IV. The model used, calibration and verification efforts;

V. NPDES and 201 alternatives.

I. PURPOSE

The Cahaba River Sewage Treatment Plant is located on the Cahaba River in Jefferson County, Alabama. In order to reissue the NPDES permit for this facility and to determine future treatment requirements, it was necessary to determine the quantity of pollutants that may be discharged to the Cahaba River without violating water quality standards. Therefore, the purpose of this modeling effort was to determine the effluent limitations required for both present conditions and future alternatives.

It had originally been anticipated that modeling conducted as part of the Environmental Impact Statement development effort on the Cahaba River would provide the technical basis for establishing these limits. However, due to certain conditions and circumstances, it was necessary that the Technical Support Branch perform the necessary examination of the data and the subsequent modeling effort. This documentation is an explanation of that effort.

II. THE STUDY AREA

The effluent from the Cahaba River STP is discharged at river mile (R.M.) 138.7 (see Figure 1). Preliminary modeling efforts indicated that the primary zone of influence of the treatment plant on the river, with respect to DO and UOD, extends approximately ten (10) miles downstream. After that, the dilution effects of the flow from Buck Creek (located at R.M. 130) predominate and the effects of the STP discharges on dissolved oxygen concentrations are negligible. Because of this, and to account for headwater conditions, the study area was limited to the Cahaba River from R.M. 144 to R.M. 129.5.

The Cahaba River below the Cahaba River STP is classified as a Fish and Wildlife stream by the Alabama Water Improvement Commission. This classification includes a DO criterion of 5.0 mg/l which was utilized as the control parameter for the modeling efforts described here.

III. AVAILABLE DATA

Intensive water quality surveys of the Cahaba River system, from river mile (R.M.) 192.3 to R.M. 93.6, were conducted by Barton Laboratory (Jefferson County) as a part of the ongoing 208 study of the area. The data (see Attachment I) from three of the four scheduled surveys were available for use in the Cahaba River modeling efforts. The fourth survey was performed in October, 1977 but the results were not used in this effort.

Time of travel (T.O.T.) studies for the Cahaba River were also available from Barton Laboratory. Discharge Measurement Summary Sheets for U.S.G.S. gaging stations located at R.M. 144 and R.M. 93 were obtained to supplement and expand the data from the T.O.T. studies. These data are found in Attachment II. A flow versus velocity relationship for the study area was formulated by developing the relationship for the two U.S.G.S. gaging stations and graphically comparing these to the T.O.T. data (see Figure 2). The resulting relationship formulated for the study area was:

$$V=0.0265\ Q^{0.513}$$

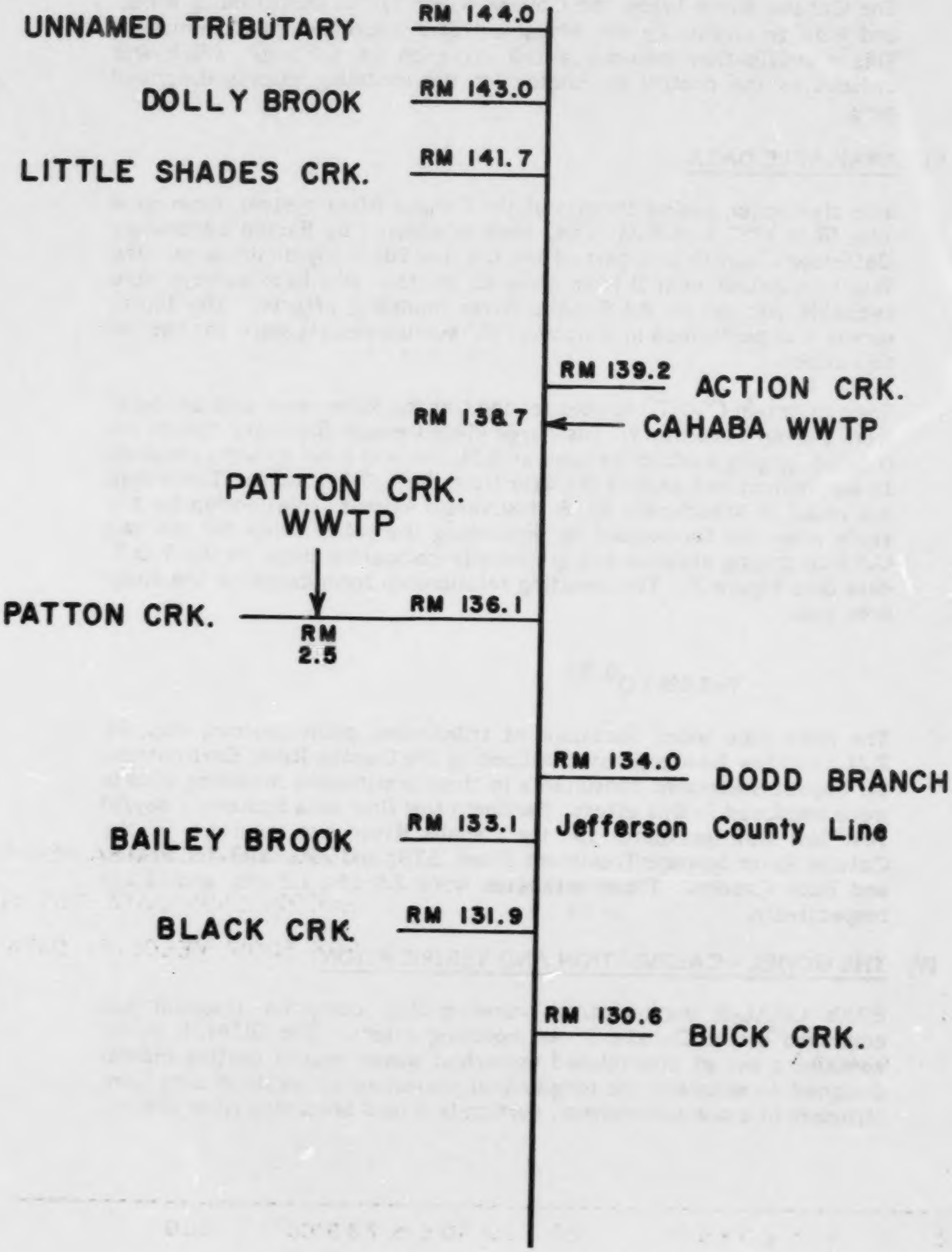
The river mile index (locations of tributaries, point sources, etc., by R.M.) and low flow estimates utilized by the Cahaba River Environmental Impact Statement consultants in their preliminary modeling efforts were employed in this effort. Pertinent low flow data included 7 day/10 year low flow estimates for the Cahaba River just upstream of the Cahaba River Sewage Treatment Plant (STP) and estimates for Patton and Buck Creeks. These estimates were 2.0 cfs, 1.2 cfs, and 12 cfs respectively.

IV. THE MODEL - CALIBRATION AND VERIFICATION

EPA's QUAL-II mathematical water quality computer program was employed in the Cahaba River modeling effort. The QUAL-II model contains a set of interrelated numerical water quality routing models designed to simulate the longitudinal variations of water quality constituents in a one dimensional, vertically mixed branching river system.

FIG. 1

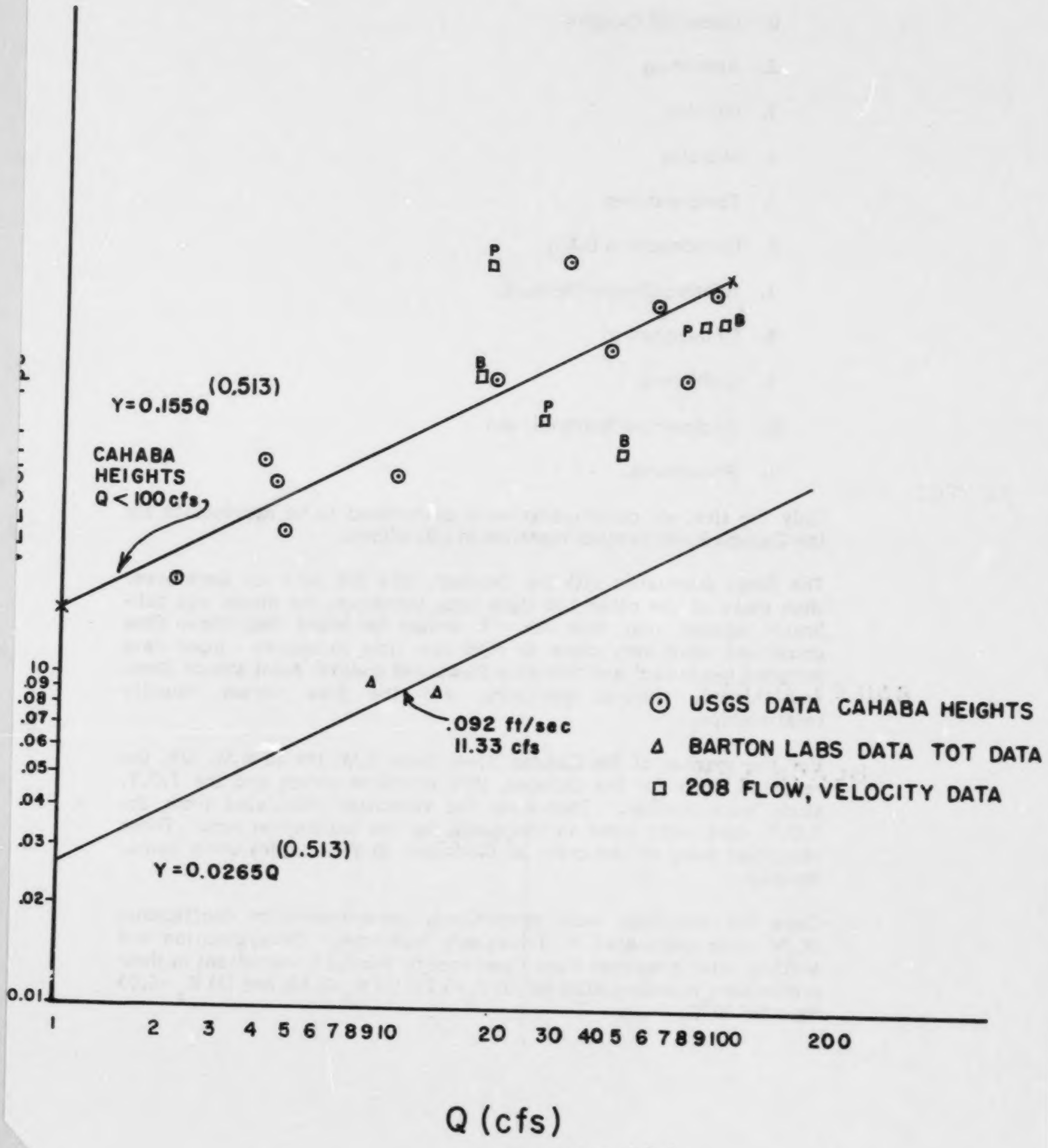
CAHABA RIVER


UNNAMED TRIBUTARY
RM 144.0
DOLLY BROOK
RM 143.0
LITTLE SHADES CRK.
RM 141.7
RM 139.2
ACTION CRK.
RM 138.7
CAHABA WWTP
PATTON CRK.
WWTP
PATTON CRK.
RM 136.1
RM
2.5
RM 134.0
DODD BRANCH
BAILEY BROOK
RM 133.1
Jefferson County Line
BLACK CRK.
RM 131.9
RM 130.6
BUCK CRK.

AII-48-a

CAHABA RIVER

FIG. 2



AII-48-b

Steady-state conditions are assumed. The model is capable of simulating the following constitutents:

1. Dissolved Oxygen;
2. Ammonia;
3. Nitrite;
4. Nitrate;
5. Temperature;
6. Carbonaceous BOD;
7. Benthic Oxygen Demand;
8. Chlorophyll a;
9. Coliforms;
10. Radioactive Material; and
11. Phosphorus.

Only the first six constituents were determined to be appropriate for the Cahaba River reaches modelled in this effort.

The flows associated with the October, 1976 208 data set were lower than those of the other two data sets; therefore, the model was calibrated against that data set. It should be noted that these flow conditions were very close to 7Q10 low flow estimates. Input data included headwater and tributary flows and quality, point source flows and quality, channel geometry, and the flow versus velocity relationships.

For the reaches of the Cahaba River from R.M. 144 to R.M. 129, the reported flows for the October, 1976 intensive survey and the T.O.T. study were similar. Therefore, the velocities calculated from the T.O.T. data were input to the model for the calibration runs. These velocities were on the order of 0.1 ft/sec. in the reaches under consideration.

Once the velocities were determined, there reaeration coefficients (K_2's) were calculated by Tsivoglou's technique. Deoxygenation and settling rates employed were those used by the E.I.S. consultant in their preliminary modeling efforts: (1) $K_1=0.25$; (2) $K_n=0.35$; and (3) $K_s=0.05$ base "e" 20°C.

Comparisons of calculated versus simulated water quality parameters are presented in Figures 3 through 5. Reasonably adequate simulations were observed. Therefore, no further adjustments were made.

Verification of the model was accomplished against the May, 1977 and June, 1977 208 data sets. Reported flows and quality were input and simulations of D.O., BOD_5, and NH_3 concentrations were run. Figures 6 through 11 are comparisons of observed versus simulated parameters for the two data sets. Reasonably adequate simulations are observed for D.O. and NH_3. The BOD_5 simulations, however, are not as good. This discrepancy appears to be caused by:

1. An undefined background bank load of BOD;
2. Due to the relatively low instream BOD concentration;
3. A combination of these factors.

V. NPDES AND 201 ALTERNATIVES

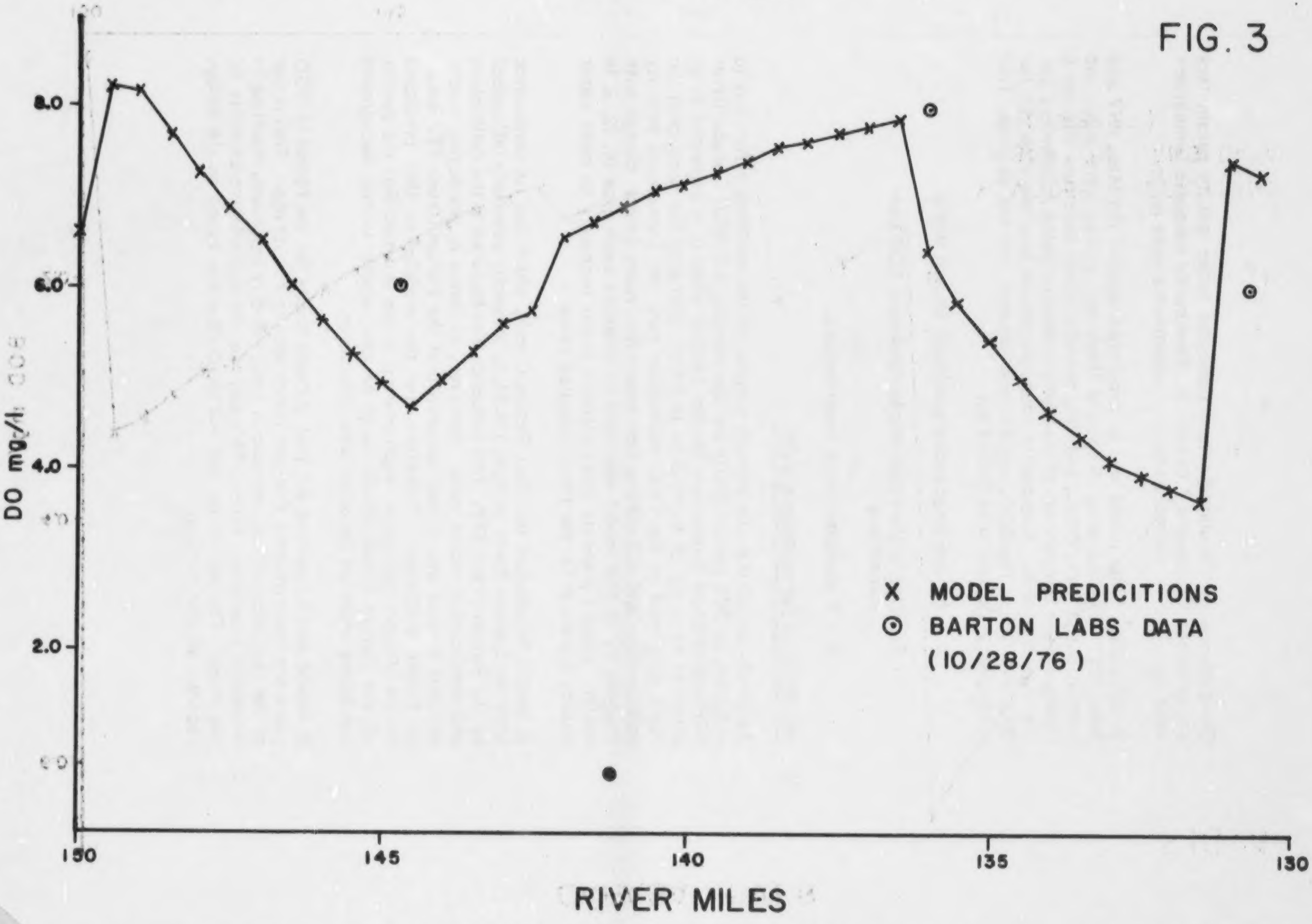
As previously stated, the primary purpose of the modeling effort was to establish NPDES permit limits for the existing 4.0 MGD Cahaba River STP and effluent limitations for the facility when it is expanded to an ultimate capacity of from 12 to 16 MGD. Utilizing the deoxygenation rates employed in the final calibration run, the formulated velocity relationship, and calculating new reaeration rates (which change with changes in Q) the model was used to evaluate each case (4, 12, & 16 MGD). Table 1 presents those effluent limits necessary to meet water quality standards for the three modelled cases.

It should be pointed out that Patton Creek, which has its confluence with the Cahaba River at R.M. 136.38, is presently adversely influenced by the Patton Creek STP. This influence was included in the calibration and verification model runs. However, in terms of predicting future effluent limitations, it was assumed that the Patton Creek STP would no longer discharge. Therefore, for the model runs that predicted future effluent limitation requirements, it was assumed that the quality of the Patton Creek flows would be comparable to the background conditions observed for other area tributaries.

It should also be pointed out that effluent limits for the 12 and 16 MGD cases are less stringent than the limits for the 4 MGD case. This is due to the fact that with an increase in flow, velocity increases, resulting in increased reaeration rates. This adds to the assimilative capacity of the river. The permit for the 4.0 MGD flow was based on the design capacity of that facility.

CAHABA RIVER

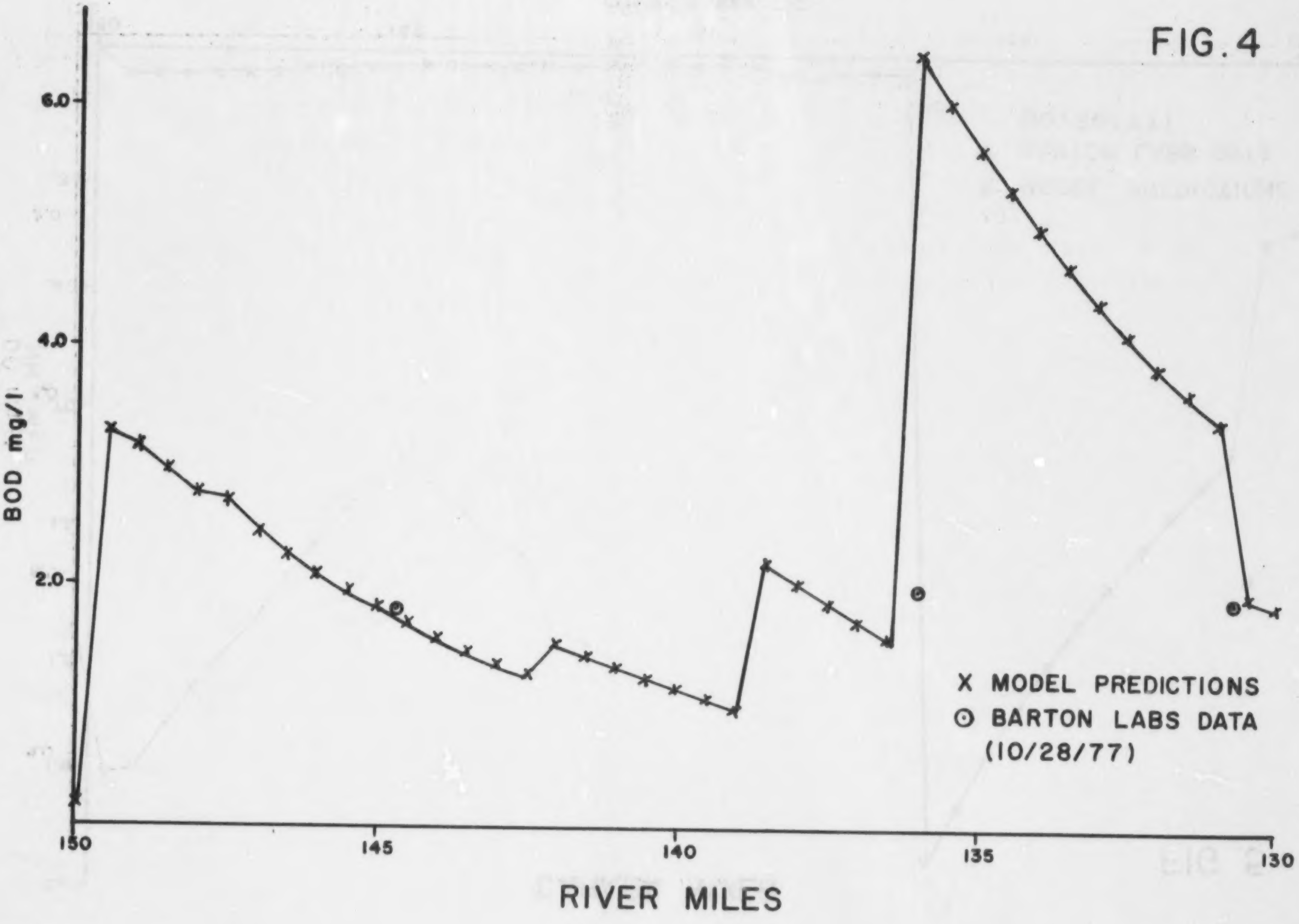
FIG. 3



AII-50-a

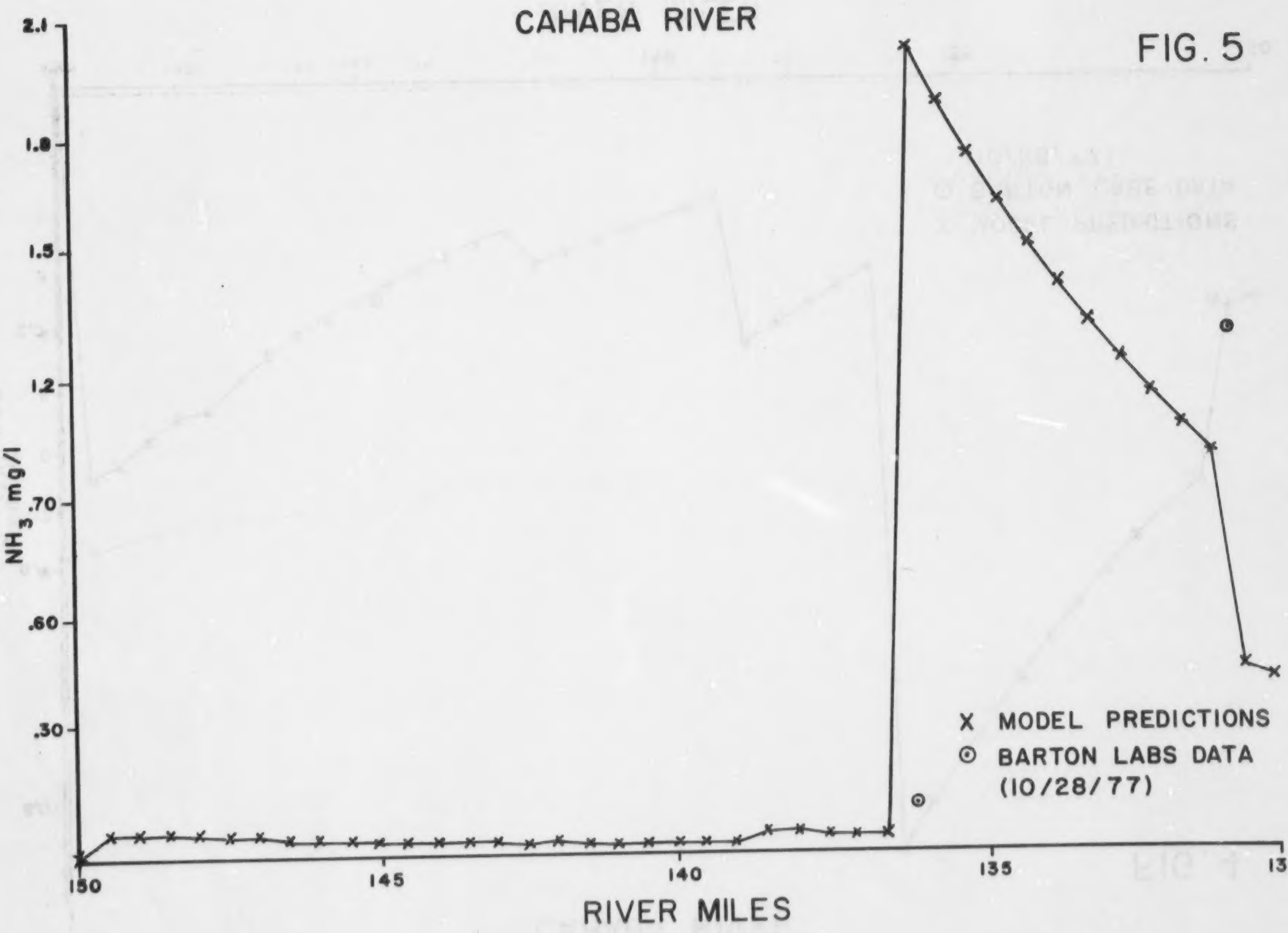
CAHABA RIVER

FIG. 4



AII-50-b

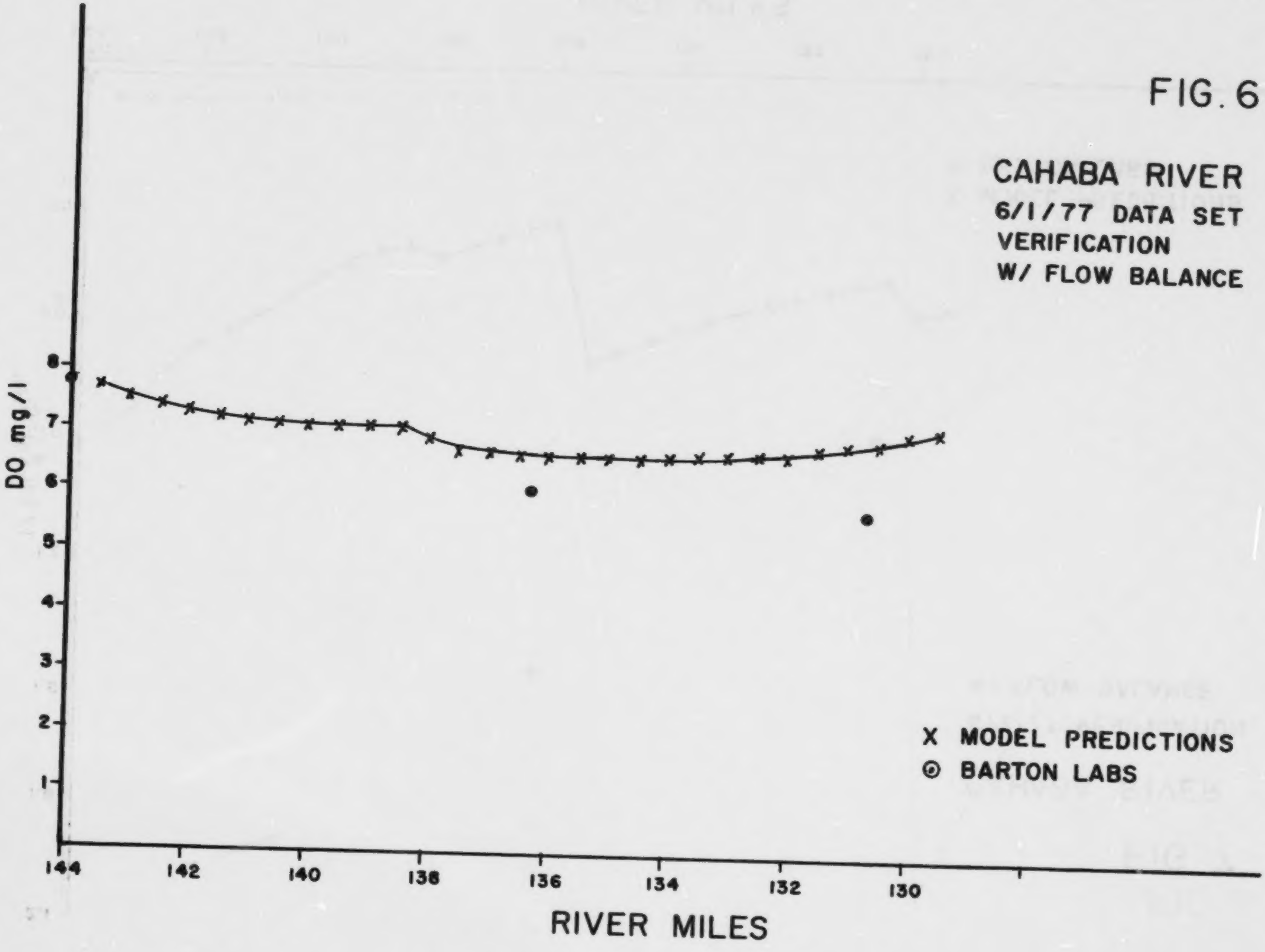
FIG. 5


CAHABA RIVER
NH$_3$ mg/l
2.1
1.8
1.5
1.2
.70
.60
.30
150
145
140
135
130
RIVER MILES
X MODEL PREDICTIONS
⊙ BARTON LABS DATA (10/28/77)

AII-50-C

FIG. 6

CAHABA RIVER
6/1/77 DATA SET
VERIFICATION
W/ FLOW BALANCE

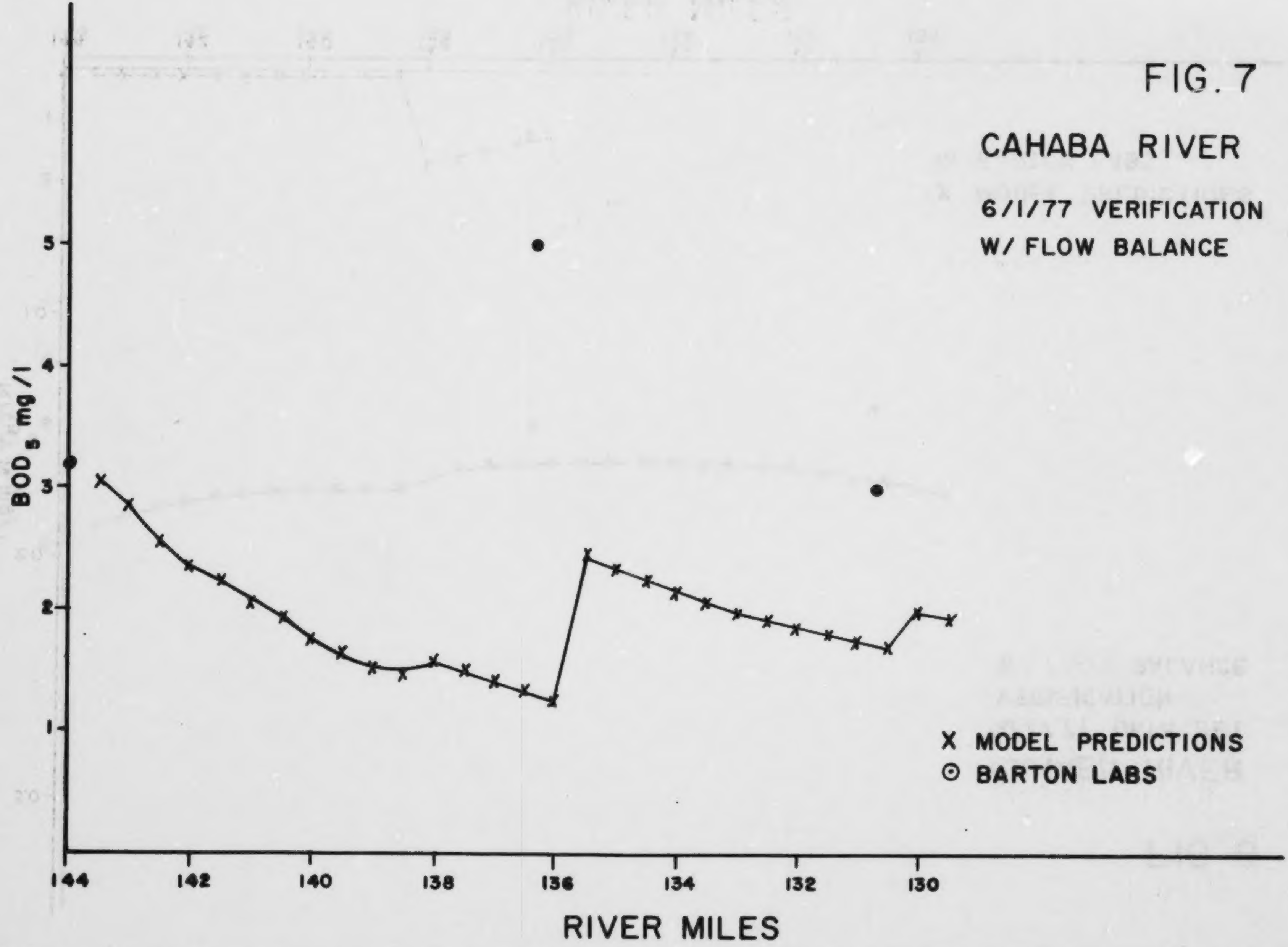


AII-50-d

FIG. 7

CAHABA RIVER

6/1/77 VERIFICATION
W/ FLOW BALANCE

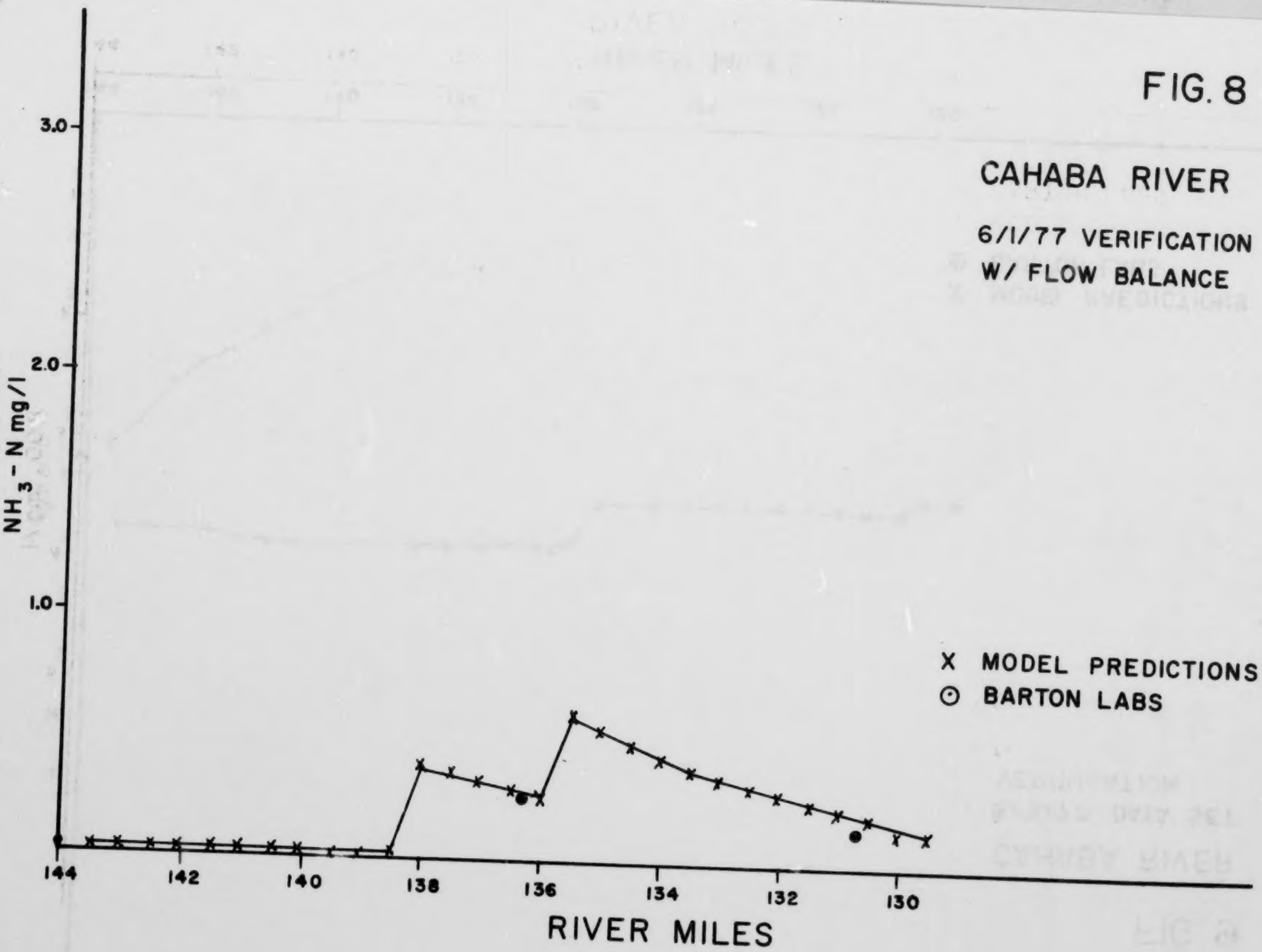


AII-50-e

FIG. 8

CAHABA RIVER

6/1/77 VERIFICATION
W/ FLOW BALANCE



AII-50-F

AEI-50.g

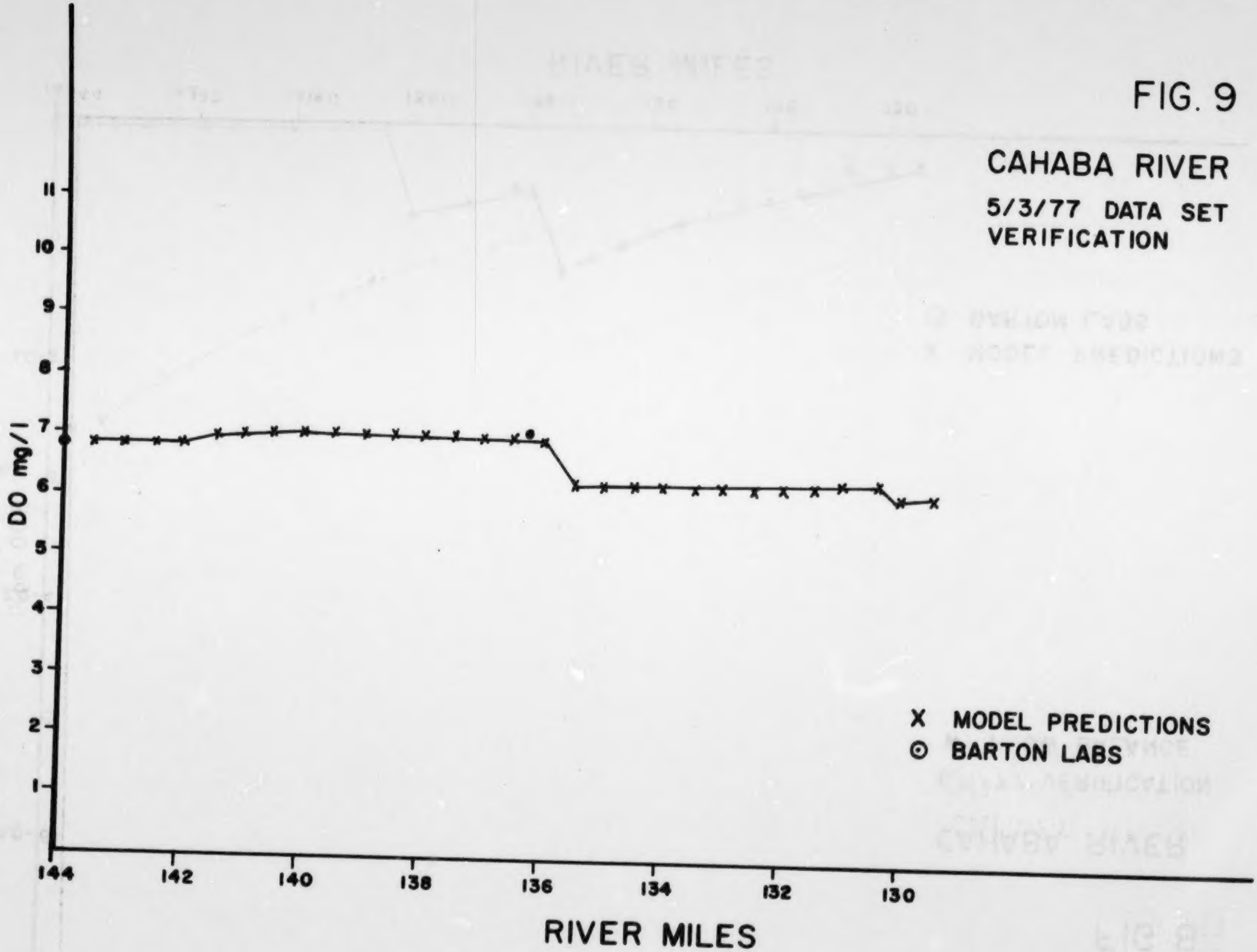
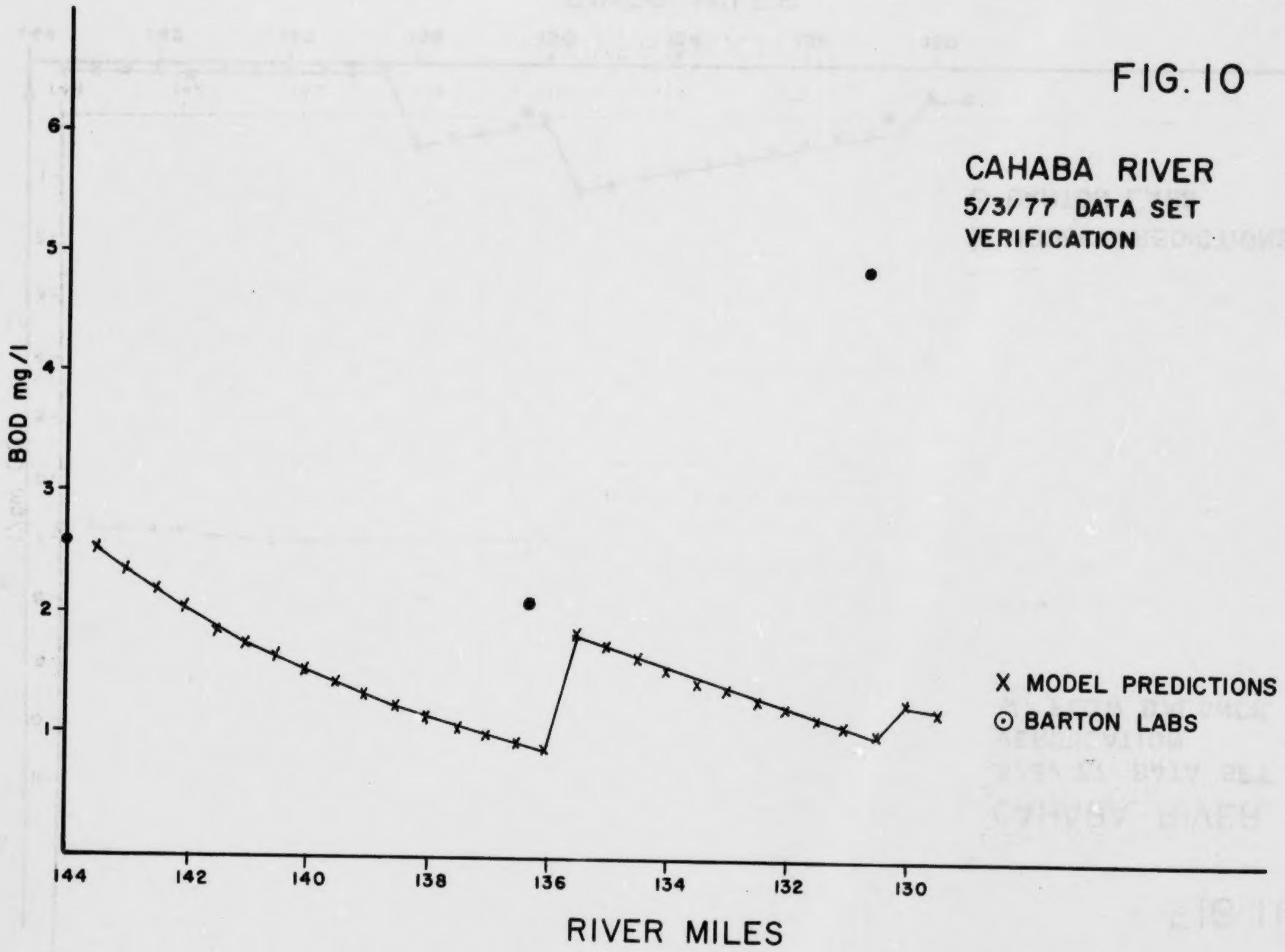


FIG. 9

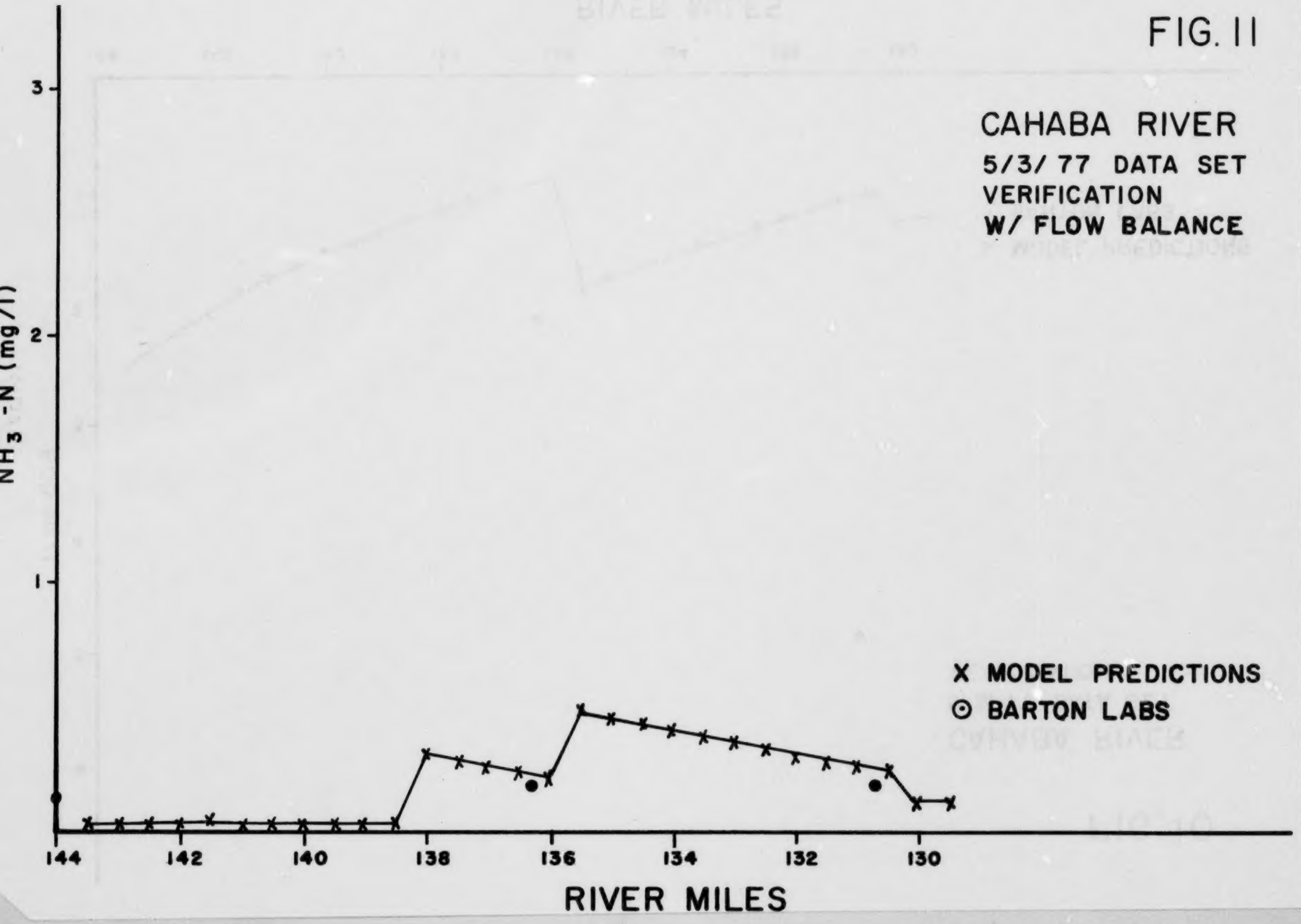
CAHABA RIVER
5/3/77 DATA SET
VERIFICATION

FIG. 10



AII-50-4

FIG. 11



CAHABA RIVER
5/3/77 DATA SET
VERIFICATION
W/ FLOW BALANCE

TABLE I

FLOW MGD	BOD_5 mg/l	NH_3-N mg/l	D.O. mg/l
4.0	5.0	1.0	7
12	8.0	0.5	7
	6.0	1.0	7
16	8.0	0.5	7
	7.0	1.0	7

WATER QUALITY DATA

BASIN Cahaba STREAM Cahaba River RM 136.

STATION NO. C-6 LOCATION Old U.S.G.S. location on downstream side location off U.S. 31 Bains Bridge

Barton Laboratory
Jefferson County Dept. of Public Works

SAMPLING DATE	1976 10-28	1977 5-3	1977 6-1			
1. Flow (cfs)	11.3	58.2	27.1			
2. D.O. (mg/l)	8.0	7.1	6.0			
3. Time		9:00	9:20			
4. Temp. Water °C	11.0	19	25			
5. Temp. Amb. °C		20.5	24			
6. BOD_5 (mg/l)	2.0	2.1	5			
7. BOD_{20} (mg/l)	7.9	3.4	36			
8. Rate Constant (1/Days)						
9. pH	6.9	7.4	7.5			
10. Conductivity (µmhos)	117	175	207			
11 IC (mg/l)	13					
12. TC (mg/l)	28					
13. TOC (mg/l)	15					
14. NH_3-N (mg/l)	.12	.19	.25			
15. NO_3-NO_2-N (mg/l)	.43	.40	.64			
16. TKN (mg/l)	1.2	.52	1.32			
17. PO_4-T (mg/l)	.5	.56	.40			
18. Alkalinity (mg/l $CaCO_3$)	85					
19. Hardness (mg/l $CaCO_3$)	85					
20. Suspended Solids (mg/l)	25.0	15	35			
21. Total Solids (mg/l)		117	147			
22. Total Dissolved Solids (mg/l)		102	112			
23. Turbidity (JTU)	34.5	8.8	160			
24. Fecal Coliform (/100 ml)	50	140	180			
25. Total Coliform (/100 ml)						
26. Fecal Strep (/100 ml)						
27. Total Plate Count (/ml)	9.2×10^3					
28. Sulfate (mg/l)		16	15			
29. Chloride (mg/l)						
30. Phenol (mg/l)						
31. CN (mg/l)						
32 Fats, Oil and Grease (mg/l)						
33. Color (APHA)						
34. Plankton Count (/ ml)						
35. Chlorophyll A,B,C (µg/l)						
36. Chlorinated Pesticides (µg/l)						
37. Fluoride (mg/l)						
38. Radioactivity (CPM)						
39. Total Volatile Solids		41	35			
40. Volatile Dissolved Solids		5	10.5			
41. Volatile Dissolved Solids		36	24.5			
42. Nitrite		.045	.078			
43.						
44.						
45.						
46.						
47.						
48.						
49.						
50.						

WATER QUALITY DATA

BASIN____________________ STREAM____________________ RM____

STATION NO. C-6 LOCATION____________________

SAMPLING DATE	1976 10-27	1977 5-3	1977 6-1			
Metals Total						
51. Cr (μg/l)	2	2	10			
52. Cd (μg/l)	6	1	1			
53. Cu (μg/l)	2	1	2			
54. Ni (μg/l)	30	100	45			
55. Zn (μg/l)	53	80	109			
56. Pb (μg/l)	1	1	4			
57. Fe (μg/l)	1060	340	181			
58. Mn (μg/l)	111	120	203			
59. Mg (μg/l)	4800	4100	6200			
60. Ca (μg/l)	8700	25300	27000			
61. K (μg/l)	4350	2610	3240			
62. Na (μg/l)	5500	5550	5230			
63. Hg (μg/l)						
64. Al (μg/l)						
65. Se (μg/l)						
66. As (μg/l)						
67. Sb (μg/l)						
Metals Dissolved						
68. Cr (μg/l)						
69. Cd (μg/l)						
70. Cu (μg/l)						
71. Ni (μg/l)						
72. Zn (μg/l)						
73. Pb (μg/l)						
74. Fe (μg/l)						
75. Mn (μg/l)						
76. Mg (μg/l)						
77. Ca (μg/l)						
78. K (μg/l)						
79. Na (μg/l)						
80. Hg (μg/l)						
81. Al (μg/l)						
82. Se (μg/l)						
83. As (μg/l)						
84. Sb (μg/l)						
Metals Benthic						
85. Cr. (μg/g)						
86. Cd (μg/g)						
87. Cu (μg/g)						
88. Ni (μg/g)						
89. Zn (μg/g)						
90. Pb (μg/g)						
91. Fe (μg/g)						
92. Mn (μg/g)						
93. Mg (μg/g)						
94. Ca (μg/g)						
95. K (μg/g)						
96. Na (μg/g)						
97. Hg (μg/g)						

WATER QUALITY DATA

BASIN Cahaba STREAM Cahaba River RM130.77

STATION NO. C-5 LOCATION R.R. Bridge just before the confluence with Buck Creek

Barton Laboratory
Jefferson County Dept. of Public Works

SAMPLING DATE	1976 10-28	1977 5-3-	1977 6-1				
1. Flow (cfs)	18.32	72.5	48.0				
2. D.O. (mg/l)	6.0	6.1	4.75				
3. Time	1:20	12:22	3:35				
4. Temp. Water °C	12.8	21	31				
5. Temp. Amb. °C	14.7	27	33				
6. BOD_5 (mg/l)	1.9	4.9	3				
7. BOD_{20} (mg/l)	14.8	8.1	8.6				
8. Rate Constant (1/Days)							
9. pH	7.0	7.5	7.6				
10. Conductivity (µmhos)	214	180	222				
11 IC (mg/l)	14						
12. TC (mg/l)	24						
13. TOC (mg/l)	10						
14. NH_3-N (mg/l)	1.30	.18	.15				
15 NO_3-NO_2-N (mg/l)	.03	.65	.77				
16. TKN (mg/l)	2.5	.90	1.02				
17. PO_4-T (mg/l)	0.7	.41	.50				
18. Alkalinity (mg/l $CaCO_3$)	35						
19. Hardness (mg/l $CaCO_3$)	35						
20. Suspended Solids (mg/l)	11.6	15	17.5				
21. Total Solids (mg/l)		134	138				
22. Total Dissolved Solids(mg/l)		119	120				
23. Turbidity (JTU)	21.5	5.4	46				
24. Fecal Coliform (/100 ml)	[illegible]	300	48				
25. Total Coliform (/100 ml)							
26. Fecal Strep (/100 ml)							
27. Total Plate Count(/ml)	$8X10^4$						
28. Sulfate (mg/l)	27	16	15				
29. Chloride (mg/l)							
30. Phenol (mg/l)							
31. CN (mg/l)							
32. Fats, Oil and Grease (mg/l)							
33. Color (APHA)							
34. Plankton Count (/ ml)							
35. Chlorophyll A,B,C (µg/l)							
36. Chlorinated Pesticides(µg/l)							
37. Fluoride (mg/l)							
38. Radioactivity (CPM)							
39. Total Volatile Solids		44	37				
40. Volatile Suspended Solids		6	8.1				
41. Volatile Dissolved Solids		38	29				
42. Nitrite		.048	.07				
43.							
44.							
45.							
46.							
47.							
48.							
49.							
50.							

WATER QUALITY DATA

BASIN Cahaba STREAM Cahaba River RM 144.7

STATION NO. C-7 LOCATION U.S.G.S. gaging station at the dam by Altadena Apts.

Barton Laboratory
Jefferson County Dept. of Public Works

SAMPLING DATE	1976 10-28	1977 5-3	1977 6-1			
1. Flow (cfs)	7.67	32.5	20			
2. D.O. (mg/l)	6.2	6.85	7.8			
3. Time		8.16	8:05			
4. Temp. Water °C	14.0	19	23			
5. Temp. Amb. °C		20	24			
6. BOD_5 (mg/l)	1.8	2.6	3.2			
7. BOD_{20} (mg/l)	6.6	2.9	9.4			
8. Rate Constant (1/Days)	-.13					
9. pH	7.1	7.5	8.25			
10. Conductivity (μmhos)	175	160	187			
11 IC (mg/l)	13					
12. TC (mg/l)	23					
13. TOC (mg/l)	10					
14. NH_3-N (mg/l)	.05	.12	.01			
15. NO_3-NO_2-N (mg/l)	.01	.27	.16			
16. TKN (mg/l)	1.6	1.09	.88			
17. PO_4-T (mg/l)	.2	.50	.33			
18. Alkalinity (mg/l $CaCO_3$)	95					
19. Hardness (mg/l $CaCO_3$)	95					
20. Suspended Solids (mg/l)	5.6	13	7.6			
21. Total Solids (mg/l)		106	105			
22. Total Dissolved Solids (mg/l)		93	97			
23. Turbidity (JTU)	5.5	7.8	22			
24. Fecal Coliform (/100 ml)	4	34	12			
25. Total Coliform (/100 ml)						
26. Fecal Strep (/100 ml)						
27. Total Plate Count (/ml)	3.6×10^3					
28. Sulfate (mg/l)	10	10	15			
29. Chloride (mg/l)						
30. Phenol (mg/l)						
31. CN (mg/l)						
32. Fats, Oil and Grease (mg/l)						
33. Color (APHA)						
34. Plankton Count (/ ml)						
35. Chlorophyll A,B,C (μg/l)						
36. Chlorinated Pesticides (μg/l)						
37. Fluoride (mg/l)						
38. Radioactivity (CPM)						
39. r^2	.95					
40. Total Volatile Solids		26	20			
41. Volatile Suspended Solids		6	6.2			
42. Volatile Dissolved Solids		20	13.8			
43. Nitrite		.007	.015			
44.						
45.						
46.						
47.						
48.						
49.						
0.						

AII-55

WATER QUALITY DATA

BASIN ____________________ STREAM ____________________ RM ___

STATION NO. C-5 ____________ LOCATION ____________________

	SAMPLING DATE	1976 10-28	1977 5-3-	1977 6-1			
Metals Total							
51. Cr	(µg/l)	3	1	1			
52. Cd	(µg/l)	6	1	1			
53. Cu	(µg/l)	<1	1	8			
54. Ni	(µg/l)	3	150	7			
55. Zn	(µg/l)	1	87	1			
56. Pb	(µg/l)	<1	1	2			
57. Fe	(µg/l)	650	370	262			
58. Mn	(µg/l)	123	150	248			
59. Mg	(µg/l)	5300	4300	6600			
60. Ca	(µg/l)	16500	26700	26800			
61. K	(µg/l)	4900	3690	3060			
62. Na	(µg/l)	12100	6600	5300			
63. Hg	(µg/l)						
64. Al	(µg/l)						
65. Se	(µg/l)						
66. As	(µg/l)						
67. Sb	(µg/l)						
Metals Dissolved							
68. Cr	(µg/l)						
69. Cd	(µg/l)						
70. Cu	(µg/l)						
71. Ni	(µg/l)						
72. Zn	(µg/l)						
73. Pb	(µg/l)						
74. Fe	(µg/l)						
75. Mn	(µg/l)						
76. Mg	(µg/l)						
77. Ca	(µg/l)						
78. K	(µg/l)						
79. Na	(µg/l)						
80. Hg	(µg/l)						
81. Al	(µg/l)						
82. Se	(µg/l)						
83. As	(µg/l)						
84. Sb	(µg/l)						
Metals Benthic							
85. Cr.	(µg/g)						
86. Cd	(µg/g)						
87. Cu	(µg/g)						
88. Ni	(µg/g)						
89. Zn	(µg/g)						
90. Pb	(µg/g)						
91. Fe	(µg/g)						
92. Mn	(µg/g)						
93. Mg	(µg/g)						
94. Ca	(µg/g)						
95. K	(µg/g)						
96. Na	(µg/g)						
97. Hg	(µg/g)						

WATER QUALITY DATA

BASIN ______ STREAM ______ RM ___

STATION NO. C-7 LOCATION ______

SAMPLING DATE	1976 10-27	1977 5-3	1977 6-1			
Metals Total						
51. Cr (μg/l)	<1	1	1			
52. Cd (μg/l)	7	1	1			
53. Cu (μg/l)	1	1	2			
54. Ni (μg/l)	10	10	1			
55. Zn (μg/l)	43	25	1			
56. Pb (μg/l)	8	1	2			
57. Fe (μg/l)	100	330	182			
58. Mn (μg/l)	42	100	54			
59. Mg (μg/l)	5360	3600	5800			
60. Ca (μg/l)	29900	25900	28000			
61. K (μg/l)	3300	2580	3710			
62. Na (μg/l)	3000	3900	1980			
63. Hg (μg/l)						
64. Al (μg/l)						
65. Se (μg/l)						
66. As (μg/l)						
67. Sb (μg/l)						
Metals Dissolved						
68. Cr (μg/l)						
69. Cd (μg/l)						
70. Cu (μg/l)						
71. Ni (μg/l)						
72. Zn (μg/l)						
73. Pb (μg/l)						
74. Fe (μg/l)						
75. Mn (μg/l)						
76. Mg (μg/l)						
77. Ca (μg/l)						
78. K (μg/l)						
79. Na (μg/l)						
80. Hg (μg/l)						
81. Al (μg/l)						
82. Se (μg/l)						
83. As (μg/l)						
84. Sb (μg/l)						
Metals Benthic						
85. Cr. (μg/g)						
86. Cd (μg/g)						
87. Cu (μg/g)						
88. Ni (μg/g)						
89. Zn (μg/g)						
90. Pb (μg/g)						
91. Fe (μg/g)						
92. Mn (μg/g)						
93. Mg (μg/g)						
94. Ca (μg/g)						
95. K (μg/g)						
96. Na (μg/g)						
97. Hg (μg/g)						

BARTON LABS' TIME OF TRAVEL DATA

CAHABA RIVER

REACH			RUN #1		RUN #2		RUN #3	
FROM	TO	MILES	TOT (hrs.)	Disc. (cfs.)	TOT (hrs.)	Disc. (cfs.)	TOT (hrs.)	Disc. (cfs.)
Pinchgut Cr. RM 182.06	Nr. Camp Coleman RM 178.92	3.14	22.2	13.6				
Nr. Camp Coleman RM 178.92	Jeff. Co. Hwy. 10 Nr. White's Chapel RM 175.47	3.45	13.2	28.4				
Jeff. Co. Hwy. 10 Nr. White's Chapel RM 175.47	U.S. Hwy. 78 Bridge RM 166.43	9.04	225.0	16.1				
U.S. Hwy. 78 Bridge RM 166.43	Grants' Mill Rd. Bridge RM 161.27	5.16	144.0	15.0				
Grant's Mill Rd. Bridge RM 161.27	River Run Development RM 153.58	7.69	79.0	23.0	13.0	228.0		
Hwy. 280 Dam RM 147.99	Cahaba River Nr. Cahaba Hgts. Gage RM 144.87	3.12						
Cahaba River Nr. Cahaba Hgts. Gage RM 144.87	Cahaba W.W.T.P. RM 139.09	5.78						
Cahaba River WWTP RM 139.09	Patton Cr. RM 136.38	2.71	41.5	8.86				
Patton Cr RM 136.38	Buck Cr. RM 130.77	5.61	91.0	13.8				
Buck Cr. RM 130.77	Booth Ford RM 108.66	22.11	140.0	145.0				
Booth Ford RM 108.66	Piper Bridge RM 93.6	12.06	94.0	248.0				

B. COST EVALUATION METHODOLOGY

INTRODUCTION

The cost evaluation of wastewater management alternatives for the Cahaba River Basin EIS involved many components. This section of the appendix describes the methodology and basis for the various cost analyses. The first part of this section deals with costing methodologies and cost analysis procedures for the wastewater facilities which comprise the alternative management systems evaluated in Chapter III. The second part of this section presents costing procedures used to evaluate other sewerage components and the no-action alternative wastewater facilities.

COST-EVALUATION OF WASTEWATER MANAGEMENT SYSTEMS

Wastewater Treatment Facilities

The cost evaluation conducted in the Cahaba River Basin study area encountered two types of costing situations. The first are the costs for new plants and the second is for upgrading/expanding existing plants. Both of these costing situations are complicated by construction phasing. In order to adequately address these situations, a costing methodology must not only provide a basis for pricing new facilities, but provide enough flexibility to price the needed treatment facilities in case of plant expansion and/or upgrading. It was felt for this study that a costing procedure which could be applied on a unit by unit basis would be sufficiently flexible. An assembly of cost estimating curves was selected and was approved by EPA to allow for the costing of treatment processes on a unit by unit basis. A breakdown of these costing curves is found in Tables AII-19 and AII-20. These two tables present the construction cost curves and operating cost curves, respectively, that were used in the cost estimates.

As noted in Chapter III, various unit processes were selected with appropriate capacities, as required to meet treatment standards and capacities for the new plants or upgraded/expanded plants. These unit process capacities were applied to the construction cost curves listed in Table AII-19 to obtain basic unit construction cost estimates. These costs were adjusted to reflect 1977 price levels in the Birmingham area using appropriate cost indices. The construction cost index values assumed for this study are as follows:

EPA Sewage Treatment Plant Index	-	216
ENR Construction Cost Index	-	1900

The total treatment plant construction cost was obtained by adding allowances for electrical, plumbing, and heating/ventilating/air conditioning contracts at 11 percent and sitework at 10 percent of the basic cost estimates.

Total project costs were determined by adding land costs and project overhead to the construction costs. The project overhead allowance covers administrative, legal, engineering, financial, and related project costs, and

TABLE AII-19

CONSTRUCTION COST ESTIMATING CURVES

UNIT PROCESS COST CURVE	INDEPENDENT VARIABLE	DESIGN ASSUMPTIONS
Raw WW Pumping	Firm Pump Capacity in MGD	-
Preliminary Treatment	Average Design Flows in MGD	-
Primary Sedimentation	Design Flow (MGD)	1250 Ft^2/MGD
Primary Sludge Pumping	Initial Firm Capacity (GPM)	
Roughing Filter	Filter Volume (1000 Ft^3)	39,000 Ft^3/MGD
Recirculation Pumping	Initial Firm Pumping Capacity (MGD)	
Aeration Basin (GHRDT)	Average Design Flow (MGD)	-
Aeration System (Mechanical)	Total Installed Capacity (Horsepower)	1 HP/1000 Ft^3 Basin
Final Sedimentation	Design Flow (MGD)	-
Return Sludge Pumping	Firm Pumping Capacity (GPM)	
Wastewater Filtration	Design Flow (MGD)	-
Carbon Adsorption	Design Flow (MGD)	-
Chlorine Contact Tank	Liquid Volume (1000 Ft^3)	20 Min. DT @ 2Q Peak
Chlorine Feed System	Avg. Chlorine Use @ Design Flow (lbs/day)	8 mg/1
Aeration System (Diffused)	Initial Firm Blower Capacity (1000 CFM)	25 CFM/1000 Ft^3 Basin
Gravity Thickening (Primary)	Average Design Flow	-
Flotation Thickening (Secondary)	Design Flow (MGD)	-
Flotation Thickening Pumping	Initial Firm Pumping Capacity	
Anaerobic Digestion	Volume (1000 Ft^3)	12,200 Ft^3/MGD
Vacuum Filtration	Filter Surface Area (Ft^2)	23 Ft^2/MGD
Administration & Lab Bldg.	Average Daily Flow (MGD)	-
Final Sedimentation w/Alum	Average Design Flow (MGD)	-
Aerobic Digestion	Basin Volume 1000 Ft^3	
Drying Beds	Average Design Flow (MGD)	-

TABLE AII-20

OPERATION AND MAINTENANCE COST ESTIMATING CURVES

UNIT PROCESS COST CURVE	INDEPENDENT VARIABLE	DESIGN ASSUMPTIONS
Raw WW Pumping	Design Flow (MGD)	-
Preliminary Treatment	Avg. Design Flow (MGD)	-
Primary Sedimentation	Surface Area (1000 Ft^2)	1250 Ft^2/MGD
Primary Sludge Pumping	Flow in GPM	-
Roughing Filter	Surface Area (1000 Ft^2)	6' Deep - 39,000 Ft^2/MGD
Recirculation Pumping	Flow in MGD	-
Aeration Basin (GHRDT)		
Aeration System (Mechanical)	Horsepower	1 HP/1000 Ft^3 Basin
Final Sedimentation	Surface Area (1000 Ft^2)	1430 Ft^2/MGD
Return Sludge Pumping	Flow in GPM	-
Wastewater Filtration	Q in MGD	-
Carbon Adsorption	Q in MGD	-
Chlorine Contact Tank		
Chlorine Feed System	Tons/Year	8 mg/1
Aeration System (Diffused)	Air Supply (1000 Ft^3)	25 CFM/1000 Ft^3 Basin
Gravity Thickener (Primary)	Surface Area (1000 Ft^2)	50 Ft^2/MGD
Flotation Thickener (Secondary)	Flow MGD	-
Flotation Thickener Pumping (To Stabilization)	Flow in GPM	-
Anaerobic Digestion	Volume(1000 Ft^2)	700 Ft^2/MGD Plus Alum for Removal of 10 mg/1 of P
Aerobic Digestion	Air Supply 1000 Ft^3	7.5 GPM Sludge-7 Days Detention
Drying Beds	Ton Dry Solids/Year	290 Tons/Year/MGD
Yardwork Maintenance	Avg. Design Flow	-
Plant Administration Labor	Avg. Design Flow	-
Lab Operations	Avg. Design Flow	-
Administration & General Expenses	Avg. Design Flow	-

amounts to approximately 28 percent of construction costs. The assumed project overhead breakdown is shown in Table AII-21. Table AII-22 presents an example calculation of construction and project costs for the Cahaba treatment plant in the Leeds-Trussville-Cahaba alternative.

The operating costs for the treatment plant alternatives were estimated using the cost curves listed in Table AII-20. These costs were based on year 2000 wastewater flows and include operation of both existing and new facilities in the plants. Costs were trended to 1977 price levels in Birmingham using the above referenced cost indices and an assumed labor cost of $5.00 per hour. Table AII-23 presents the operating cost calculations for the Cahaba plant example.

It was necessary to give two cases special costing consideration. The first is the Trussville Plant which has an oxidation ditch with aeration rotor. Because there are no cost curves developed for the process, it was necessary to estimate the cost of expansion from 1 MGD to 1.25 MGD. The cost of the present oxidation ditch was obtained from the Jefferson County Sanitation Department and was used as the basis for a ratio to compute the cost of expansion. This cost figure was adjusted to account for inflation. The remainder of the plant expansion which included the final clarifier, return sludge pumping, the chlorine contact tank, and the chlorine feed system was priced using the unit cost curves.

Spray irrigation, the other special consideration, is discussed in the following subsection.

Land Application Facilities

As discussed in Chapter III of the EIS, spray irrigation of treatment plant effluent from the Leeds and Upper Cahaba plants was evaluated. The Pine Mountain area north of Leeds was the potential spray irrigation site selected for this analysis.

The salient characteristics of the Pine Mountain Area pertaining to spray irrigation are contained in Table AII-24. Site location is 2.6 and 3.9 miles from the Leeds and Upper Cahaba treatment plants, respectively (transmission main lengths). Adaptibility of the strip mining portion of the site to land application is in question and will require more extensive field investigation.

The cost analysis workup was primarily taken from "Costs of Wastewater Treatment by Land Application", EPA-430/9-75-003. The cost curves in this 1976 U.S. EPA publication itemize individual components utilized in land application. Both capital costs and operation and maintenance costs are included in the analysis. Preapplication treatment costs for both Leeds and Upper Cahaba were obtained from the cost curves assembled by GFCC, and previously reviewed by EPA for the Birmingham EIS. Capital costs were related to present (1977) dollars in the Birmingham area by using the appropriate cost indices.

Table AII-25 lists the capital and operation and maintenance costs associated with each component of the spray irrigation scheme. The following points should be noted concerning the cost of several of the components.

TABLE AII-21

BREAKDOWN OF PROJECT OVERHEAD AS A PERCENTAGE OF CONSTRUCTION AND SITE COSTS

Item	% For Treatment Plants (1)	% For Land (2)
Legal, Administrative, Miscellaneous	1%	1%
Financial, Including Bond Discounting & Interest During Construction	6%	6%
Engineering Design	6%	0
Engineering Inspection, Including General & Direct	5%	0
Contingencies	10%	5%
Total	28%	12%

(1) From letter to R. Koch (GFC&C) from R.D. Erwin, Jr., Sanitary Engineer Jefferson County Commission dated 3/31/77.

(2) Estimated by GFC&C for spray irrigation land.

TABLE AII-22

UNIT PROCESS CONSTRUCTION AND PROJECT COSTS
CAHABA PLANT - LEEDS-TRUSSVILLE-CAHABA

Unit Process	Construction Costs (1) 1982	1989	Construction Cost Curve
Raw Wastewater Pumping	$ 432,000		Raw Wastewater Pumping
Preliminary Treatment	230,400		Preliminary Treatment
Primary Sedimentation	869,000	$ 316,000	Primary Sedimentation
Primary Sludge Pumping	40,320	34,600	Primary Sludge Pumping
Roughing Filter	432,000	201,600	Trickling Filtration
Recirculating Pumping	230,400		Recirculation/Intermediate Pumping
Aeration Basin (6 hr)	482,600	355,600	Aeration Basin
Aeration System (Mechanical)	172,800	122,400	Aeration/Mechanical Aerators
Intermediate Pumping			
Final Sedimentation	632,000	331,800	Final Clarification
Return Sludge Pumping (7.5 mgd)	417,600		Sludge Pumping
Wastewater Filtration (2)	748,000	360,000	Wastewater Filtration
Carbon Adsorption (3)	2,448,000	1,296,000	Carbon Adsorption
Chlorine Contact Tank	74,900	46,100	Cl_2 Contact Basin
Chlorine Feed System	22,000	51,800	Chlorination Feed Systems
Aeration System	74,880	43,200	Aeration Diffused Air System
Gravity Thickener	118,500		Gravity Thickening
Gravity Thickener Pumping	36,000		Sludge Pumping
Flotation Thickening	268,600		Flotation Thickening
Flotation Thickening Pumping	36,000		Sludge Pumping
Anaerobic Digester	547,200		Anaerobic Digestion
Vacuum Filter	460,800		Vacuum Filtration
Administration & Lab Building	172,800		Administration & Lab Buildings
Yardwork Maintenance			
Plant Administration Labor			
Laboratory Operations			
Administration & General Expenses			
Subtotals - Treatment Level 1	$5,802,800	$1,503,100	
Treatment Level 2	$6,550,800	$1,863,100	
Treatment Level 3	$8,998,800	$3,159,100	
HVAC & Plumbing & Electrical 11% of Subtotal			
Sitework 10% of Subtotal			
Land at $1,500/acre (4)		N/A	
Project Overhead (28% of all above)			
Totals - Treatment Level 1	$ 9,027,697	$4,893,000	
Treatment Level 2	$10,193,879	$2,886,000	
Treatment Level 3	$13,994,941	$2,328,000	

(1) Based on Design Flows in Unit Capacities Table.
(2) Applies to Treatment Level 2 and 3 only.
(3) Applies to Treatment Level 3 only.
(4) Treatment Level 1 - 21 acres, Level 2 - 25 acres, Level 3 - 30 acres.

TABLE AII-23

UNIT PROCESS OPERATION, MAINTENANCE, MATERIALS, AND SUPPLY COSTS
CAHABA PLANT - LEEDS-TRUSSVILLE-CAHABA

Unit Process	Operation and Maintenance Costs (1)				
	Maintenance	Operation	Materials and Supply	Total	Operation & Maintenance, Materials & Supply Cost Curves
Raw Wastewater Pumping	4,500	6,000	4,032	14,532	Raw Wastewater Pumping
Preliminary Treatment	7,500	17,000	7,776	32,276	Preliminary Treatment
Primary Sedimentation	4,000	7,500	3,744	15,244	Primary Sedimentation
Primary Sludge Pumping	1,250	2,900	2,304	6,500	Sludge Pumping
Roughing Filter	2,400	3,250	1,512	7,162	Trickling Filtration
Recirculating Pumping	4,500	6,000	4,032	14,500	Recycle/Intermittent Pumping
Aeration System (Mechanical)	7,500	14,000	56,200	77,660	Activated Sludge Mechanical Aeration (O&M, M&S)
Final Sedimentation	4,250	8,500	4,320	17,100	Sedimentation (O&M, M&S)
Return Sludge Pumping (7.5 mgd)	11,000	25,000	21,600	57,600	Sludge Pumping
Wastewater Filtration (2)		11,500	86,900	98,400	Wastewater Filtration (O&M, M&S)
Carbon Adsorption (3)		42,500	118,500	161,000	Carbon Adsorption
Chlorine Contact					
Chlorine Feed System	1,740	7,500	43,100	50,700	Chlorination (O&M, M&S)
Aeration System	2,600	5,600	11,808	20,108	Activated Sludge Diffused Air (O&M, M&S)
Gravity Thickener	668	18,800	600	20,100	Gravity Thickening
Gravity Thickener Pumping	900	2,200	1,768	4,800	Sludge Pumping
Flotation Thickening		15,000	18,170	33,170	Flotation Thickening Annual
Flotation Thickening Pumping	900	2,200	1,728	4,800	Sludge Pumping
Anaerobic Digester	6,500	11,000	6,624	24,100	Anaerobic Digestion
Vacuum Filter	5,000	45,000	21,900	71,900	Vacuum Filtration
Administration & Laboratory Building					
Yardwork Maintenance	17,000		3,466	20,500	Yardwork (O&M, M&S)
Plant Administration Labor		14,000		14,000	Plant Administration Labor (O)
Laboratory Operations		23,000	3,888	27,900	Laboratory Operation & Supplies (O, M&S)
Administration & General Expenses			7,200	7,200	Administration & General Expenses (M&S)
Totals - Treatment Level 1				$541,852	
Treatment Level 2				$640,252	
Treatment Level 3				$801,252	

(1) Based on Year 2000 Flows = 14.66 mgd. Includes existing and new facilities.
(2) Applies to Treatment Level 2 and 3 only.
(3) Applies to Treatment Level 3 only.

TABLE AII-24

SPRAY IRRIGATION SITE SUMMARY

Pine Mountain Area (north of Leeds)

SOIL - HME Hector & Montevallo (gravelly fine sandy loam)
(shaly silt loam)
HLD Hartsells & Linkar (fine sandy loams)

SLOPES - 7 - 45%

GROUNDCOVER - Mixed pine (majority) and hardwood forests
Several strip mined areas

LAND USE ACTIVITIES - Forest harvesting (primarily pine)
Mining

OWNERSHIP - U.S. Steel

LIMITATIONS - Soil pH 4-5.5 (may limit denitrification in soil system)
Slope limitations in some areas

COST - $1,000 - $1500/acre

TABLE AII-25

SPRAY IRRIGATION COMPONENT COSTS

Component	Reference	Leeds		Upper Cahaba	
		Capital Cost	Operation & Maintenance	Capital Cost	Operation & Maintenance
Land	EPA-430/9-75-003 Figure 3	480,000	-	855,000	-
Storage Pond	EPA-600/2-76-250 EPA-430/9-75-003 Figure 23	151,000	970	236,000	1,420
Field Preparation	EPA-430/9-75-003 Figure 24, 25	451,000	-	867,000	-
Transmission Main	*Ibid*, Figure 20	273,000	560	500,000	1,050
Transmission Pumping	*Ibid*, Figure 21	253,000	9,990	374,000	17,470
Distribution Pumping	*Ibid*, Figure 33	226,000	5,680	306,000	9,400
Distribution	*Ibid*, Figure 28	116,000	17,540	342,000	31,420
Service Roads & Fencing	*Ibid*, Figure 41	119,000	2,560	153,000	3,510
Preapplication Treatment	GFCC Cost Curves	801,000	56,690	2,551,000	154,300
Total		3,373,000	94,000	7,066,000	217,250

1) Land - The cost curve gives total land area required with a 200-feet peripheral buffer, road areas, storage areas, and building areas. A maximum application rate of 2 inches/week and annual nonoperating time of 4 weeks due to cold weather were used. The year 2000 design loadings were considered.

2) Storage Pond - A pond with sufficient storage for 15 days' flow was used as indicated in "Use of Climatic Data in Estimating Storage Days for Soil Treatment Systems", EPA-600/2-76-250.

3) Field Preparation - Cost includes site clearing and land leveling.

4) Transmission Mains - Pipe diameter was used to maintain a minimum velocity of 3.0 to 8.0 feet per second from average to peak flows.

5) Transmission Pumping - Dynamic head of 150 feet was assumed.

6) Distribution - Center pivot mechanism was employed for Leeds; center pivot and solid set were used for Upper Cahaba.

Wastewater Conveyance Facilities

The conveyance facilities used in this study include pumping stations, gravity sewers (interceptors), and force mains. The location and layout of each of these facilities depends a great deal on the actual site topography. These conveyance facilities were designed for the year 2020 peak flows.

The construction costs for the gravity sewers and force mains were estimated in detail including items such as mobilization (contractor time to get his team together and to the site), clearing, excavating and backfilling, special conditions and crossings, manholes, and type of pipe and installation. The O & M costs for the sewers, however, were considered negligible when compared to O & M costs incurred by other facilities. Consequently, they were not considered in this evaluation.

The pumping station construction costs were determined from a costing curve with adjustments for TDH based on topographic considerations. The O & M and M & S costs were also based on established cost curves. These prices were all adjusted to reflect 1977 Birmingham prices.

Flow Augmentation Facilities

As described in Chapter III and Part A of this Appendix, stream flow augmentation facilities were components of several of the wastewater management alternatives considered in the EIS. Three of the four augmentation alternatives were previously developed by other agencies as noted in Table AII-26. The project costs for these alternatives were taken from the respective studies while the O & M costs were worked up by GFC&C. The fourth alternative (Big, Middle, and Little Black Creek Reservoirs) was developed and costed for both project and O&M costs by GFC&C in developing the project costs for the three Big Black Creek reservoirs, the actual breakdown of costs was done only for the Little Black Creek Reservoir. The costs for the other two reservoirs were derived using the ratios of the cut and fill volumes of the remaining two reservoirs to that of the Little Black Creek Reservoir. This breakdown can be found on Tables AII-27 and AII-28.

TABLE AII-26

FLOW AUGMENTATION SYSTEMS

Alternative	Total Project Cost (1) (1000 $)	Annual O&M Costs (1000 $)	Estimated Safe Yield (cfs)	Land Requirements (Acres)
Lake Purdy Expansion (2)	6,960	25	11	309.4
Big Black Creek Reservoir	6,458	36	19	1520
Middle Black Creek Reservoir	2,207	30	7	270
Little Black Creek Reservoir	5,075	34	15	1070
Combined Big, Middle, & Little Black Creek Reservoirs	13,739	65	41	2860
Big Black Creek Basin Reservoir (2)	9,500	45	41	3000
Relocation of Water (2) (3) Supply Intake to Lake Purdy	18,000	22		

(1) Project costs include construction costs, land and legal, engineering, financial and administrative costs.

(2) Based on cost information provided by Birmingham Municipal Water Works Board, and contained in Malcolm Pirnie, Inc. engineering report, "Water Supply Study for the Water Works Board of the City of Birmingham, Alabama, 4/77".

(3) Includes pumping water from Black Creek system to Lake Purdy system.

TABLE AII-27

RESERVOIR COSTS SUMMARY
BIG BLACK CREEK

	Little	Middle	Big	Total
Dam & Reservoir Construction	2,060,400	983,500	2,726,900	5,770,800
Relocation (Bridge & Highway) From Other Studies	800,000	400,000	800,000	2,000,000
Total Construction	2,860,400	1,383,500	3,526,900	7,770,800
Engineering Design, Inspection, Legal and Fiscal Fees 40% Construction	1,144,200	553,400	1,410,800	3,108,400
Land Purchase $1000/acre	1,070,000	270,000	1,520,000	2,860,000
Project Costs	5,074,600	2,206,900	6,457,700	13,739,200

TABLE AII-28

LITTLE BLACK CREEK RESERVOIR
BREAKDOWN OF COSTS

Item	Quantity	Unit Cost	Total Cost ($)
Clearing & Grubbing	902 AC	$400	360,800
Embankment (cut & fill)	322,636 c.y.	3	967,900
Subsurface Exploration	LS		50,000
Riprap - Upstream Face	7,000 c.y.	14	98,000
		Subtotal	1,476,700
Service Spillway			
Concrete	1,190 c.y.	$200	238,000
Stone Bedding	320 c.y.	10	3,200
Riprap d/s Channel	370 c.y.	14	5,200
		Subtotal	246,400
Outlet Works			
Pipe Conduit (36" Ø)	575'	$ 75	43,200
Concrete Piles for Conduit	810'	20	16,200
Diaphragms	56 c.y.	300	16,800
Terminal Structures	LS		20,200
Riser & Gate Structure	LS		36,800
Housing Over Gate Structure	LS		7,500
Intake Structures	LS		8,100
		Subtotal	148,800
Hydraulic Seeding	50 AC	$500	25,000
CMP Toe Drainage (24"-12")	LS		34,600
Cutoff Trench Excavation	32,800	3	98,400
		Subtotal	158,000
		Total	2,029,900
Mobilization, Bond & Insurance		1.5%	30,500
		Total Reservoir Construction	2,060,400
Relocation (Roads, Bridges, etc.)			800,000
		Total Construction	2,860,400
Engineering Design, Inspection, Legal & Fiscal		40%	1,144,120
Land Purchase	1,070 AC	$1,000	1,070,000
TOTAL PROJECT			5,074,520

The operation and maintenance costs for the flow augmentation facilities were estimated using Birmingham Municipal Water Works Board estimates for the operation and maintenance of Lake Purdy. These costs were adjusted as needed to approximate the O & M costs for the other reservoir alternatives.

Present Worth Analysis

The U.S. EPA guidelines require that the alternative treatment systems be evaluated on a present worth and/or equivalent annual cost basis over the duration of the planning period. In order to compare all alternatives on an equal basis, the cost effectiveness analysis is extended to all components of a given alternative. Costs to be considered include all capital costs for implementing a given project as well as the operation and maintenance costs needed to adequately ensure effective and dependable facility operation at the design treatment level. Where facilities are scheduled to function beyond the end of the planning period, a credit is given for salvage values.

These salvage values account for those treatment plant components that are normally anticipated to function beyond the 18-year planning period used for the cost analysis. Salvage values are generally considered as a percentage of the initial construction costs and although these percentages were not determined specifically for each alternative, they were based upon previous investigations of average salvage values for various types of treatment plants. Table AII-29 summarizes the salvage values for the conveyance systems and wastewater treatment plants of the various alternatives.

The present worth and equivalent annual cost analysis for the wastewater treatment facilities is based on 1977 price levels, an 18 year planning period ending in 2000, and an interest rate of 6.375 percent which is the federal discount rate to be used for the evaluation of water and related land resources projects.

The present worth analysis of wastewater facilities costs is composed of two parts. The first is the operation and maintenance costs and the second part is the capital and total cost analysis. An example of the procedure can be found on Tables AII-30 and AII-31 which present the analysis performed on the Leeds-Trussville-Cahaba alternative including the three levels of treatment at the Cahaba plant.

Table AII-30 illustrates the present worth analysis performed on the operation and maintenance costs for the Leeds-Trussville-Cahaba alternative. Operating costs for initial years of operation were estimated by scaling down the year 2000 cost using modified flow ratios. Operating costs of plants prior to upgrading or expanding were based on present County experience. The present worth calculation was based on a uniform cost gradient from 1985 to the year 2000. All costs were discounted to a 1982 present worth.

The calculation of the capital cost present worth is illustrated in Table AII-31 for the alternative. As shown in the table, the present worth analysis was separated into the three construction phases. For each facility component within each phase, total project costs are discounted to a 1982 present worth. Year 2000 salvage values, computed as previously discussed, were also discounted to the year 1982 and deducted for the project cost present worth.

TABLE AII-29

YEAR 2000 - SALVAGE VALUE AS A PERCENTAGE OF INITIAL CONSTRUCTION COSTS

Type of Facility	Year of Construction		
	1982	1984	1989
Conveyance[1]	64	68	78
Wastewater Treatment Plants[2]			
Equipment	5	10	22.5
Structures	27.5	30	36.25
Total	33	40	59
Pumping Stations[3]			
Equipment	3.33	6.66	15
Structures	36.66	46.66	48.33
Total	40	53.3	63.3

(1) Conveyance Facilities
50 years - Straightline Depreciation

(2) Wastewater Treatment Plants
1/2 Equipment - 20 Years - Straightline Depreciation
1/2 Structures- 40 Years - Straightline Depreciation

(3) Pumping Stations
1/3 Equipment - 20 Years - Straightline Depreciation
2/3 Structures- 40 Years - Straightline Depreciation

TABLE AII-30

CAHABA RIVER BASIN EIS
ALTERNATIVE WASTEWATER SYSTEMS COST ANALYSIS
OPERATION AND MAINTENANCE COST PRESENT WORTH CALCULATIONS (1)
ALTERNATIVE: LEEDS-TRUSSVILLE-CAHABA

	Treatment Plants						
	Cahaba level 1	Cahaba level 2	Cahaba level 3	Leeds	Trussville	Conveyance Facilities	Total
Wastewater Flows							
1) 1983 (mgd)	9.52	9.52	9.52	.90	.83		
2) 1985 (mgd)	10.58	10.58	10.58	1.05	1.06		
3) 2000 (mgd)	14.66	14.66	14.66	1.40	1.25		
O&M Cost Ratios (2)							
4) 1983/2000	.825	.825	.825				
5) 1985/2000	.861	.861	.861	.875	.924		
C&M Costs							
6) Year 2000	542,000	640,000	801,000	155,000	113,000		
7) Year 1983-1984 (line 4 x line 6)	447,000	528,000	661,000	144,000	80,000		
8) Year 1985 (line 5 x line 6)	467,000	551,000	690,000	136,000	104,000		
9) O&M Cost Gradient ((line 6 - line 8)/8)	5,000	5,953	7,400	1,266	600	10,000	
10) 1982 P.W. of 'Fixed Cost' (8.7052 x line 8) (3)	4,065,000	4,797,000	6,007,000	1,184,000	905,000		
11) 1982 P.W. of Gradient (54.0398 x line 9) (4)	270,000	321,000	400,000	68,000	32,000		
12) 1982 P.W. of 1983/84 Costs (1.8238 x line 7) (5)	815,000	963,000	1,206,000	263,000	146,000		
Total Operation and Maintenance 1982 Present Worth for:							
Cahaba level 1	5,150,000			1,515,000	1,083,000	107,000	7,855,000
Cahaba level 2		6,081,000		1,515,000	1,083,000	107,000	8,786,000
Cahaba level 3 (lines 19_21+23)			7,613,000	1,515,000	1,083,000	107,000	10,318,000

(1) Present worth analysis based on present (1977) price levels, 18-year planning period ending in 2000, and 6.375 percent discount rate.
(2) Based on one half of the percentage difference of initial flows to design flows.
(3) Composite factor equals 0.88373 x 9.85061.
(4) Composite factor equals 0.88373 x 61.1497.
(5) Composite factor equals 0.94007 + 0.88373.

TABLE AII-31

CAHABA RIVER EIS
ALTERNATIVE WASTEWATER SYSTEMS COST ANALYSIS
CAPITAL AND TOTAL COST PRESENT WORTH CALCULATIONS (1)
ALTERNATIVE: LEEDS-TRUSSVILLE-CAHABA

	Phases 1 (1982) and 3 (1989) Construction						Phase 2 (1984) Construction					Total Capital (8+16)	Total O&M (Table)	Grand Total (17+18)
	Treatment Plants			Conveyance		Total	Treatment Plants		Conveyance		Total			
	Cahaba-1	Cahaba-2	Cahaba-3	Sewers	Pump Sta.		Leeds	Trussville	Sewers	Pump Sta.				
Phases 1 and 2														
1) Project Cost	9,028	10,194	13,995	4,053	623		1,416	513	267	90				
2) Project 1982 Present Worth (factor x line 1) (2)	9,028	10,194	13,995	4,052	623		1,252	453	236	80				
3) 200 Salvage Value (factor x line 1) (3)	2,979	3,364	4,618	2,594	249		567	205	182	48				
4) Salvage 1982 Present Worth (0.32877 x line 3)	979	1,106	1,518	853	82		186	67	60	16				
5) Net Present Worth (line 2 - line 4)	8,049	9,088	12,477	3,200	541		1,066	386	176	64				
Phase 3														
6) Project Cost	2,328	2,886	4,893	2,017										
7) Project 1982 Present Worth (0.64882 x line 6)	1,510	1,872	3,175	1,309										
8) 2000 Salvage Value (factor x line 6) (4)	1,374	1,703	2,887	1,573										
9) Salvage 1982 Present Worth (0.32877 x line 8)	452	560	949	517										
10) Net Present Worth (line 7 - line 9)	922	1,312	2,226	792										
Total Net Capital 1982 Present Worth for:														
Cahaba level 1	8,971			3,902	541	13,504	1,066	386	176	64	1,692	15,196	7,855	23,051
Cahaba level 2		10,400		3,992	541	14,933	1,066	386	176	64	1,692	16,625	8,786	25,411
Cahaba level 3 (line 10 + line 21)			14,703	3,992	541	19,236	1,066	386	176	64	1,692	20,928	10,318	31,246
Average Annual Equivalent Cost for:														
Cahaba level 1														2,184
Cahaba level 2														2,413
Cahaba level 3 (0.094974 x lines 26, 27, 28)														2,968

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(1) Present worth analysis based on present (1977) price levels, 18-year planning period ending in 2000, and 6.375 percent discount rate. All costs in $1,000's.

(2) Factor equals 1.00 for Phase 1 and 0.88373 for Phase 2.

(3) Factor equals 0.33 for plants and pump stations and 0.64 for sewers for Phase 1, and 0.40 and 0.68, respectively, for Phase 2. Factor equals 1.00 for spray irrigation land.

(4) Factor equals 0.59 for plants and pump stations and 0.78 for sewers.

Total alternative present worths were obtained by combining the operating cost and capital cost present worths (reference Table AII-31) for each alternative.

The present worth analysis done on the flow augmentation facilities differs from the preceeding present worth analysis in two ways. The first is that no depreciation is assumed for the dams or adjacent land and the second is that the annual O & M costs are assumed to be the same from year to year.

Local Annual Cost Analysis

The local annual cost analysis is a method by which the economic impact on the local units is examined. The local annual cost analysis of wastewater facilities uses the total present worth figure and subtracts from that the expected federal grant leaving the local share. This local share is converted into an annual debt service by a debt service factor (.08914) representing 6.375% interest for 25 years and 10% coverage. The 1985 O & M costs are added to the annual debt service to obtain the total annual local costs.

It should be noted that on certain alternatives, assumptions were made which could affect the annual local costs. It was assumed that no federal grant would be made on any flow augmentation facility. There is also a possibility of greater than 75 percent federal grant on the spray irrigation facilities; however, this was not assumed either. If either of these grants were offered, the local annual costs would be decreased for selected alternatives.

COST EVALUATION OF OTHER WASTEWATER FACILITIES

In preparation of the cost analysis for the eleven structural alternatives, certain elements of the overall wastewater treatment facilities scheme were not considered since they were common to all nine alternative plans. Comparison, however, of the single selected structural alternative with the no-action alternative necessitates the cost evaluation of certain of these previously unincluded components. In this cost comparison again, any component which would be included in both alternatives needs not be considered.

Collection Systems

Five residential areas within the Birmingham EIS study area have been slated to be included within the regional wastewater facilities scheme. These areas were selected based upon total local population and population density. At the present, none of these five areas is serviced by a wastewater conveyance network and will need to be cost evaluated and now incorporated with the selected structural alternative cost analysis.

Components included in the cost estimate are the collection laterals, trunk sewers including wastewater conveyance to the main interceptor, force mains, and pumping stations. The cost curves utilized in the cost work up are taken from the EPA-approved, GFC&C-assembled information.

The laterals are assumed to be 8" diameter with 6-12 feet cuts yielding a $23.7/L.F. capital cost. Trunk lines leading to the main interceptor are 12" diameter sewers with 6-12 feet cuts assumed. This results in a $30.0/L.F. capital cost. Force mains are 4" and 8" diameters at $7.9/L.F. and $12.6/L.F., respectively. Pumping station costs were uniformly estimated to be $40,000 each.

Table AII-32 summarizes the component needs for each conveyance system as well as their capital or construction cost.

County-Owned Facilities

If federal funds were not utilized by Jefferson County for its wastewater facilities, i.e., the no-action alternative were chosen, some combination of the following four courses of action could be pursued:

1) Utilization of all excess capacity of the existing treatment plants
2) Local funding of the new regional wastewater facilities
3) Local funding of smaller package wastewater treatment plants
4) Use of individual on-lot disposal systems

To locally fund the entire regional wastewater facilities system would impose prohibitively high local annual costs and therefore is dismissed here as a feasible option under the no-action alternative.

Under the no-action alternative there would be no capital investments in new regional facilities, but the operation and maintenance costs would have to be accounted for in a cost comparison with the selected structural alternative. The O & M costs for the two alternatives would differ, the selected structural alternative having a higher associated cost.

Table AII-33 lists the O & M costs realized for 1974 and the projected 1978 costs. The NPDES Permit flows and 1978 projected average flows are also shown.

Package Wastewater Treatment Plants

Certain larger residential developments under the no-action plan will be densely populated enough to financially support a package treatment plant. Components considered in cost analysis of such a package plant are the WWTP itself, outfall sewers, and local collection system.

Cost curves obtained from "Wastewater Treatment Facilities of Sewered Small Communities", EPA-625/1-77-079 (10/77) were utilized in cost analysis of the treatment plant and ancillary works. The outfall is a 0-6 feet and 6-12 feet cost averaged cut with a 12" diameter. The collection system is a 6-12 feet cut with an 8" diameter sewer section. Their index adjusted respective costs are $18.2/LF and $15.8/LF. These cost figures are taken from the GFC&C assembled cost curves previously reviewed by EPA.

TABLE AII-32

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT

CONSTRUCTION AND PROJECT COST ESTIMATES
FOR
LOCAL COLLECTION SYSTEMS

Collection System	Construction Cost	Project Cost
Cahaba Heights		
95,200 ft. of 8-inch collector	$2,256,000	$2,888,000
1 Pump Station	$ 40,000	$ 51,000
2,600 ft. of 4-inch force main	$ 21,000	$ 26,000
Total	$2,317,000	$2,965,000
Mountain Brook		
78,000 ft. of 8-inch collector	$1,849,000	$2,366,000
4,000 ft. of 12-inch trunk	$ 120,000	$ 154,000
Total	$1,969,000	$2,520,000
Overton		
23,700 ft. of 8-inch collector	$ 566,000	$ 725,000
3,400 ft. of 12-inch trunk	$ 102,000	$ 130,000
2 Pump Stations	$ 80,000	$ 101,000
5,600 ft. of 4-inch force main	$ 44,000	$ 57,000
Total	$ 791,000	$1,013,000
Roebuck Plaza		
30,800 ft. of 8-inch collector	$ 758,000	$ 971,000
18,000 ft. of 12-inch trunk	$ 540,000	$ 692,000
1 Pump Station	$ 40,000	$ 51,000
4,600 ft. of 8-inch force main	$ 58,000	$ 75,000
Total	$1,396,000	$1,789,000
Moody		
5,000 ft. of 8-inch collector	$ 119,000	$ 152,000
23,400 ft. of 12-inch trunk	$ 702,000	$ 899,000
Total	$ 821,000	$1,051,000

TABLE AII-33

JEFFERSON COUNTY WASTEWATER FACILITIES OPERATION & MAINTENANCE COSTS

	O&M Costs		Flows	
	1974	1977-78	NPDES	1977-78
Leeds	22,306	57,300	1.0	1.1
Trussville	27,293	80,000	1.2	1.1
Cahaba	150,022	317,700	2.2	2.4
Patton Creek	81,354	154,000	4.0	4.4

The following two assumptions were made concerning the collection system for these future development areas:

1) Assumed population density was based on three households per acre and three people per household.

2) 90 feet of sewer per household was assumed.

A graph was developed which relates the number of households within such a development area to the length of outfall sewer which can be constructed to a proper receiving stream. A $300 maximum annual user fee constrains the relationship of these two variables. The graphical representation was developed by: 1) selecting various sized populations; 2) estimating the total project cost that would be incurred; 3) amortizing this amount; 4) adding the O & M annual costs to this amount; 5) taking the difference of this and the $300 maximum user fee. The amount remaining would be available annually over the period of amortization to initially construct the outfall sewer.

Drawing upon this graphical relationship, areas within the EIS study region which have been identified as future development tracts were reviewed as to the feasibility of their supporting a package plant, given their size and distance from a receiving stream. If the length of outfall sewer for the given development area extends to a proper receiving stream (in most cases the Cahaba River) under the $300 maximum user fee, then the development tract was classified as being feasible.

There were eleven development tracts which met the above criteria for package plants. Table AII-34 itemizes all of the associated package plant costs incurred for each of these eleven development tracts.

Septic Tank Systems

Under both the selected structural alternative and the no-action alternative, there exists a portion of the present and future populations which will have to be served by septic tank systems as a means of wastewater disposal.

At the commencement of the analysis period both alternatives will have an equal number of septic tank services. With the construction of the wastewater treatment facilities under the selected structural alternative, the number of services would decline by 50% through the 18-year planning period. Under the no-action alternative, the number of septic services would decrease slightly, due to the construction of package plants.

Construction costs were estimated at $1,000 for each new septic tank service while the operation and maintenance costs were placed at $25 per year per service. Table AII-35 tabulates the costs incurred for septic tank service with both alternative plans.

Present Worth Analysis

The present worth analysis for the collection systems, package treatment plants, and on-lot disposal systems follows the same basic procedures as previously outlined for present worth analysis of wastewater management systems. Certain special considerations for the analysis of these facilities, however, are noted below.

TABLE AII-34

PACKAGE TREATMENT PLANTS FOR FUTURE DEVELOPMENT TRACTS

Development Tract	Year 2000 Population	Outfall Length	Collection System Length	Total 1982 Present Worth	1985 O&M	Total Project Cost	1985 Total Local Annual Cost
1	10,800	0	324,000	7,847,800	68,200	8,688,800	842,800
2	1,800	0	54,000	1,481,400	20,200	1,530,800	156,700
3	5,060	0	151,900	3,840,100	40,200	4,149,600	410,100
4	1,500	1,000	45,000	1,312,900	18,900	1,336,900	138,100
5	620	2,000	18,000	646,000	11,200	625,000	66,900
6	540	2,500	16,200	601,300	10,100	584,100	62,100
7	450	1,500	13,500	486,600	8,600	467,700	50,300
8	6,050	1,500	180,000	4,457,200	38,300	4,931,700	47,800
9	560	500	16,200	536,800	10,500	507,300	55,700
10	450	500	13,500	452,300	8,600	429,300	46,900
11	450	500	13,500	452,300	8,600	429,300	46,900
Total				22,110,000	243,400	23,680,000	2,354,400

TABLE AII-35

SEPTIC SYSTEM COSTS ACTION/NO ACTION

	Action	No Action
Project Cost	$ 775,000	$ 2,885,000
Annualized Project Cost	43,050	160,250
1985 O&M	467,500	506,700
Present Worth Project Costs	453,150	1,687,300
Present Worth O&M	4,446,700	4,817,100
Total Present Worth	4,899,900	6,504,000
Local Annual Costs	510,600	666,900

Based upon the facilities construction phasing, the five new collection systems were assumed to take place in the years listed below.

Roebuck Plaza - 1984
Overton - 1989
Moody - 1984
Cahaba Heights - 1982
Mountain Brook - 1982

The eleven package treatment plants were assumed to have been constructed by 1982. The initial operation and maintenance costs of these facilities were adjusted downward from the year 2000 full flow cost.

No salvage value was assumed for the septic tanks at the end of the planning period. Construction was assumed to occur equally over the 18-year planning period. An annualized project cost is computed rather than the annual debt service. The operation and maintenance costs for septic tank systems is a decreasing gradient series since both the action and no action plans decrease in total number of septic tanks throughout the 18 years.

Local Annual Cost Analysis

Here again the methodology of the local annual cost analysis is as previously outlined. The annual debt service is added to the annual O & M cost. However, for the septic tank systems, the local annual costs were calculated by taking the annualized project costs (not debt service) and adding to this the operation and maintenance costs. Also, no federal grants were assumed to be available for any of the privately-owned facilities.

C. OPERABILITY EVALUATION

INTRODUCTION

The operability evaluation of wastewater management system alternatives involves these general considerations: reliability of treatment, flexibility of operation, and maintainability of facilities. For the Cahaba River Basin EIS this evaluation was conducted in two parts. The first was an evaluation of wastewater treatment facilities and the second involved the evaluation of wastewater facilities combined with flow augmentation facilities. In both cases, certain basic evaluation criteria were adhered to.

EVALUATION CRITERIA

The general operability evaluation criteria selected for use in determining the alternatives' operability ratings are summarized below in outline form:

1. Reliability
    a. Lower wastewater treatment levels are more reliable than higher treatment levels.
    b. Multiple facilities are just as reliable as single facilities.
    c. Older facilities are not as reliable as new facilities.
    d. Spray irrigation of treatment plant effluent is less reliable than surface water discharge of effluent.
2. Flexibility
    a. There is no difference in flexibility among levels of treatment.
    b. Multiple facilities are more flexible than single (regional) facilities.
    c. New facilities are more flexible than older facilities.
    d. Spray irrigation of effluent is less flexible than surface discharge.
3. Maintainability
    a. Facilities with lower wastewater treatment levels are more maintainable than those with higher levels.
    b. Multiple facilities are less maintainable than single (regional) facilities.

c. New facilities are more maintainable than older facilities.

d. Treatment facilities with spray irrigation of effluent are just as maintainable as treatment facilities with surface discharges.

EVALUATION PROCEDURES

The evaluation criteria were applied first to the alternative wastewater treatment systems to determine their relative operability rankings. The ranking points assigned to each alternative were determined by a committee of sanitary engineers familiar with the Cahaba Basin facilities. A total of 1000 points was selected to be available for distribution among the alternatives. It was judged that approximately one-third should be assigned to each of the three areas of general consideration, in order to weigh reliability, flexibility, and maintainability equally. The results of this analysis are presented in Table III-17 in Chapter III of the EIS.

In the analysis of the total wastewater management systems, the above ratings were adjusted to account for the effect of respective flow augmentation facilities operating with the treatment plants. The following rating adjustments were judged appropriate:

	Reliability	Flexibility	Maintainability	Total
No Augmentation	0	0	0	0
Big Black Creek Reservoir	-2	2	-2	-2
Lake Purdy Expansion	-2	2	-1	-1
Black Creek Reservoir	-2	2	-2	-2
Black Creek Res. with Relocated Water Intake	-4	2	-3	-5

The results of the overall operability evaluation rating is presented in Table III-18 in Chapter III.

D. ENVIRONMENTAL IMPACTS

In Chapter III of the EIS, an environmental impacts comparison of the various wastewater management alternatives for the study area was presented. This section of Appendix II consists of Table AII-36, which gives a detailed explanation of the various impacts quantified in Chapter III.

TABLE AII-36

SUMMARY OF SIGNIFICANT ENVIRONMENTAL IMPACTS

Basic Alternatives with Surface Discharge

Environmental Factor	No Action	Cahaba	Upper Cahaba-Cahaba	Trussville-Cahaba	Overton-Cahaba	Patton Creek-Upper Cahaba-Cahaba
Odor	. Increase in local sources from increased use of package plants . Continual odor problems at Lake Purdy and Lake Paradise . Potential for odor creating algal blooms in Cahaba River	. Decrease in eutrophication odor at Lake Purdy and Paradise Lake . Potential for odor creating algal blooms in Cahaba River	. Decrease in eutrophication odor at Lake Purdy and Paradise Lake . Potential for odor creating algal blooms in Cahaba River	. Decrease in eutrophication odor at Lake Purdy and Paradise Lake . Potential for odor creating algal blooms in Cahaba River	. Decrease in eutrophication odor at Lake Purdy and Paradise Lake . Potential for odor creating algal blooms in Cahaba River	. Decrease in eutrophication of Lake Purdy . Eutrophication of Paradise Lake varying with plan of modification . Potential for odor producing algal blooms in the Cahaba River
Topography						
Geology		Possible construction problem from placement of 215,725 feet of interceptor and force main on unstable shale bedrock.	Possible construction problem from placement of 150,400 feet of interceptor and force main on unstable shale bedrock.	Possible construction problem from placement of 154,750 feet of interceptor and force main on unstable shale bedrock.	Possible construction problem from placement of 200,075 feet of interceptor and force main on unstable shale bedrock.	Possible construction problem from placement of interceptor and force main on unstable shale bedrock, varying with modification of Patton Creek: a) Patton Creek STP upgraded and discharged to Patton Creek: 135,875 feet b) Patton Creek STP upgraded and discharged directly into Cahaba River: 147,950 feet c) Patton Creek STP maintained or only used as pumping station; in either case, sewage pumped to Cahaba STP: 150,400 feet
Soils		Temporary soil erosion during construction from placement of 215,725 feet of interceptor.	Temporary soil erosion during construction from placement of 150,400 feet of interceptor.	Temporary soil erosion during construction from placement of 154,750 feet of interceptor.	Temporary soil erosion during construction from placement of 200,075 feet of interceptor.	Temporary soil erosion during construction from placement of interceptor, the degree varying with the Patton Creek STP modification.

TABLE AII-36 (Cont'd.)

SUMMARY OF SIGNIFICANT ENVIRONMENTAL IMPACTS

Environmental Factor	Leeds-Trussville Cahaba	All Basic Alternatives Land Disposal	Lake Purdy	Black Creek	Lake Purdy Intake	Warrior River	Warrior River and Cahaba River
Odor	. Nutrients from Leeds STP may contribute to L. Purdy odors; P removal at the STP should reduce this impact . Decreased eutrophication of Paradise Lake . Potential for odor producing algal blooms in the Cahaba River	. Potential at site	. Potential increase in odor producing hypolimnion by raising dam height ten feet	. Impounding may result in formation of same odor producing hypolimnion	. Increase in odor potential from heavy draw down of lake		
Topography		. Physical alteration of disposal site	Increase in surface area of lake by 76% (730 acres)	Increase in surface area of water by impoundment	Decrease in surface area of Lake Purdy during heavy draw-down		
Geology	. Possible construction problems from 79,800 feet of interceptor and force main . If Leeds discharges to the Cahaba River construction problems from additional 14,750 feet of force main and interceptor	Construction problems from placement of interceptor and force main on unstable shale bedrock a) Upper Cahaba-Cahaba 13,000 feet b) Trussville-Cahaba 39,125 feet of which 375 feet crosses stream in 4 locations c) Overton-Cahaba 54,775 feet of which 43,775 feet follows stream bottom and 375 feet crosses stream bed in 4 locations d) Leeds Trussville Cahaba 1) 2,000 feet if Leeds only 2) 41,125 feet if Leeds & Trussville	Moderate construction problems	Moderate construction problems	Possible construction problems from placement of 26,000 feet of transmission main on unstable shale bedrock	Possible construction problems from placement of transmission main on unstable shale bedrock: a) Coosa River 173,000 feet to Lake Purdy b) Mulberry Fork 158,000 feet c) Locust Fork 158,000 or 181,000 feet depending on location of intake	Possible construction problems from placement of transmission main on unstable shale bedrock: a) Coosa River 112,000 feet b) Mulberry Fork 158,000 feet c) Locust Fork 158,000 or 181,000 feet depending on location of intake
Soils	Temporary soil erosion during construction from placement of 79,800 feet of interceptor	Temporary soil erosion during construction from placement of interceptor, the degree varying with alternative	Erosion of banks prior to stabilization	Erosion of banks prior to stabilization	Temporary soil erosion during construction from placement of 26,000 feet of transmission main	Temporary soil erosion during construction from placement of transmission main varying with chosen modifications	Temporary soil erosion during construction from placement of transmission main varying with chosen modifications

TABLE AII-36 (Cont'd.)

SUMMARY OF SIGNIFICANT
ENVIRONMENTAL IMPACTS

Environmental Factor	No Action	Cahaba	Upper Cahaba-Cahaba	Trussville-Cahaba	Overton-Cahaba	Patton Creek-Upper Cahaba-Cahaba
Plants	. Loss of agricultural lands to urbanization . Loss of natural vegetation and woodlands to suburban sprawl	. Loss of agricultural lands to encroaching urbanization . Loss of native vegetation and woodland to suburban sprawl . Temporary loss of native vegetation over 29,125 feet of interceptor . Creation of more diverse woodland habitat along interceptor right of way through secondary succession	. Loss of agricultural lands to encroaching urbanization . Loss of native vegetation and woodland to suburban sprawl . Temporary loss of native vegetation over 27,275 feet of interceptor . Creation of more diverse woodland habitat along interceptor right of way through secondary succession	. Loss of agricultural lands to encroaching urbanization . Loss of native vegetation and woodland to suburban sprawl . Temporary loss of native vegetation over 34,275 feet of interceptor . Creation of more diverse woodland habitat along interceptor right of way through secondary succession	. Loss of agricultural lands to encroaching urbanization . Loss of native vegetation and woodland to suburban sprawl . Temporary loss of native vegetation over 81,425 feet of interceptor . Creation of more diverse woodland habitat along interceptor right of way through secondary succession	. Loss of agricultural lands to encroaching urbanization . Loss of native vegetation and woodland to suburban sprawl . Loss of terrestrial habitat varying with Patton Creek STP modification: a) Patton Creek STP upgraded and discharges into Patton Creek: 12,750 feet of interceptor b) Patton Creek STP upgraded and discharges into Cahaba River : 12,750 feet of interceptor c) Patton Creek STP maintained or used as pump station; in either case, sewage pumped to Cahaba STP: 27,275 feet . Creation of more diverse habitat along interceptor right of way through secondary succession
Animals	. Loss of wildlife and wildlife habitat to urbanization . If urban development is unplanned the habitat of certain rare and endangered species may be encroached upon	. Loss of wildlife and wildlife habitat from urbanization . Creation of more diverse wildlife habitat along 29,125 feet of interceptor through secondary succession . Temporary loss of stream bottomland habitat along 186,000 feet of interceptor . Potential loss of southeastern shrew habitat	. Loss of wildlife and wildlife habitat from urbanization . Creation of more diverse wildlife habitat along 27,275 feet of interceptor through secondary succession . Temporary loss of stream bottomland habitat along 123,125 feet of interceptor . Potential loss of southeastern shrew habitat	. Loss of wildlife and wildlife habitat from urbanization . Creation of more diverse wildlife habitat along 34,275 feet of interceptor through secondary succession . Temporary loss of stream bottomland habitat along 120,475 feet of interceptor . Potential loss of southeastern shrew habitat	. Loss of wildlife and wildlife habitat from urbanization . Creation of more diverse wildlife habitat along 81,425 feet of interceptor through secondary succession . Temporary loss of stream bottomland habitat along 118,650 feet of interceptor . Potential loss of southeastern shrew habitat	. Loss of wildlife and wildlife habitat from urbanization . Creation of more diverse wildlife habitat along interceptor through secondary succession, the degree varying with modification of Patton Creek STP . Temporary loss of streambottom land habitat, the degree varying with modification of Patton Creek STP . Potential loss of southeastern shrew habitat

TABLE AII-36 (Cont'd.)

SUMMARY OF SIGNIFICANT
ENVIRONMENTAL IMPACTS

Environmental Factor	Leeds-Trussville Cahaba	All Basic Alternatives Land Disposal	Lake Purdy	Black Creek	Lake Purdy Intake	Warrior River	Warrior River and Cahaba River
Plants	. Loss of agricultural lands to encroaching urbanization . Temporary loss of natural vegetation over 24,825 feet of interceptor and force main	Increased growth of vegetation at site	Inundation of approximately 700 acres of pine and hardwood forest adjacent to the lake	Inundation of valley and loss of upland vegetation at reservoir site	. Temporary loss of forest cover along 26,000 feet of transmission main right of way . Possible loss of rare and endangered plant: Hymenocaliis coronaria	. Temporary loss of forest cover along transmission main right of way varying with modification	. Temporary loss of forest cover along transmission main right of way varying with modification
Animals	. Loss of wildlife and wildlife habitat from urbanization . Creation of more diverse habitat through secondary succession along 24,825 feet of interceptor . Temporary loss of stream bottomland habitat along 54,975 feet of interceptor	. Disruption of ecosystem at spray irrigation site	. Loss of approximately 700 acres of wildlife habitat adjacent to lake . Inundation and loss of 57.9 acres of red cockaded woodpecker habitat	. Loss of wildlife habitat from inundation of valley . Potential loss of southeastern shrew habitat	Temporary loss of wildlife habitat from transmission main construction	Temporary loss of wildlife habitat from transmission main construction	Temporary loss of wildlife habitat from transmission main construction

TABLE AII-36 (Cont'd.)

SUMMARY OF SIGNIFICANT ENVIRONMENTAL IMPACTS

Environmental Factor	No Action	Cahaba	Upper Cahaba-Cahaba	Trussville-Cahaba	Overton-Cahaba	Patton Creek-Upper Cahaba-Cahaba
Surface Water	. Continued degradation of surface waters. . Potential pathogenic viral or chemical contamination of drinking water supply.	. Greatest potential for improved water quality above Cahaba STP. . Predicted 7 day, 10 year low flow average total inorganic nitrogen concentrations: a) River miles 179-152 - approx. 3 mg/1 b) Miles 148-140 - approx. 0.5 mg/1 c) Below Cahaba STP - approx. 14 mg/1 . Nitrogen concentrations between Miles 179-152 maximum below Gold-Kist Plant discharge; some background from non-point sources. . Immediately below the Cahaba STP total phosphorous may range from 4-7 mg/1 depending on flow down Cahaba River, 20 cfs to 2 cfs respectively. . Potential for increased nutrient levels: a) Upstream from Cahaba STP, especially if Gold-Kist Plant not upgraded, in natural pools or impounded areas with increased detention time and increased light level permitting nuisance algal blooms or spread of macrophytes. b) Downstream of Cahaba STP for similar reasons; light-filtering tree canopy may reduce impact. . Greatest decrease in potential of viral and other contaminants in drinking water by placing all STP effluent downstream from water supply intake.	. Predicted day, 10 year low flow average total inorganic nitrogen concentrations: a) River miles 179-152 - approx. 5 mg/1 b) Miles 148-140 - approx. 1 mg/1 c) Below Cahaba STP - approx. 13 mg/1 . Immediately below Cahaba STP total phosphorous may range from 4-7 mg/1 depending on flow down Cahaba River, 20 cfs to 2 cfs respectively. . Immediately below Upper Cahaba STP after mix with river, total phosphorous may be on the order of 1 mg/1 at a 7-day, 10 year low flow (assuming no input from Gold-Kist Plant). . Potential for increased nutrient levels: a) Upstream from Cahaba STP, especially if Gold-Kist Plant not upgraded, in natural pools or impounded areas with increased detention time and increased light level permitting nuisance algal blooms or spread of macrophytes. b) Downstream of Cahaba STP for similar reasons; light-filtering tree canopy may reduce impact.	. Predicted 7 day, 10 year low flow average total inorganic nitrogen concentration: a) River miles 179-152 - approx. 6 mg/1 b) Miles 148-140 - approx. 0.5 mg/1 c) Below Cahaba STP - approx. 13 mg/1 . Immediately below Cahaba STP total phosphorous may range from 4-7 mg/1 depending on flow down Cahaba River, 20 cfs to 2 cfs respectively. . Immediately below Trussville STP after mix with river, total phosphorous may be on the order of 2 mg/1 at a 7 day, 10 year low flow (assuming no input from Gold-Kist Plant). . Potential for increased nutrient levels: a) Upstream from Cahaba STP, especially if Gold-Kist Plant not upgraded, in natural pools or impounded areas with increased detention time and increased light level permitting nuisance algal blooms or spread of macrophytes. b) Downstream of Cahaba STP for similar reasons; light-filtering tree canopy may reduce impact.	. Predicted 7 day, 10 year low flow average total inorganic nitrogen concentration: a) River miles 179-152 - approx. 6 mg/1 b) Miles 148-140 - approx. 1 mg/1 c) Below Cahaba STP - approx. 13 mg/1 . Immediately below Cahaba STP total phosphorous may range from 4-7 mg/1 depending on flow down Cahaba River, 20 cfs to 2 cfs respectively. . Immediately below Overton STP after mix with river, total phosphorous may be on the order of 1 mg/1 at a 7 day, 10 year low flow (assuming no input from Gold-Kist Plant). . Potential for increased nutrient levels: a) Upstream from Cahaba STP, especially if Gold-Kist Plant not upgraded, in natural pools or impounded areas with increased detention time and increased light level permitting nuisance algal blooms or spread of macrophytes. b) Downstream of Cahaba STP for similar reasons; light-filtering tree canopy may reduce impact.	. Predicted 7 day, 10 year low flow average total inorganic nitrogen concentrations: a) River miles 179-152 - approx. 5 mg/1 b) Miles 148-140 - approx. 1 mg/1 c) Below Cahaba STP - approx. 13 mg/1 . Immediately below Cahaba STP total phosphorous may range from 4-7 mg/1 depending on flow down Cahaba River, 20 cfs to 2 cfs respectively. . Immediately below Upper Cahaba STP after mix with river, total phosphorous may be on the order of 1 mg/1 at a 7 day, 10 year low flow (assuming no input from Gold-Kist Plant). . Potential for increased nutrient levels: a) Upstream from Cahaba STP, especially if Gold-Kist Plant not upgraded, in natural pools or impounded areas with increased detention time and increased light level permitting nuisance algal blooms or spread of macrophytes. b) Downstream of Cahaba STP for similar reasons; light-filtering tree canopy may reduce impact.

TABLE AII-36 (Cont'd.)

SUMMARY OF SIGNIFICANT
ENVIRONMENTAL IMPACTS

Environmental Factor	Leeds-Trussville Cahaba	All Basic Alternatives Land Disposal	Lake Purdy	Black Creek	Lake Purdy Intake	Warrior River	Warrior River and Cahaba River
Surface Water	. Predicted 7 day, 10 year low flow average total inorganic nitrogen concentration: a) River miles 179-152 - approx. 6 mg/1 b) Miles 148-140 - approx. 1 mg/1 c) Below Cahaba STP - approx. 13 mg/1 . Immediately below Cahaba STP total phosphorous may range from 4-7 mg/1 depending on flow down Cahaba River, 20 cfs to 2 cfs respectively. . Immediately below Trussville STP after mix with river, total phosphorous may on the order of 2 mg/1 at 7 day, 10 year low flow (assuming no input from Gold-Kist Plant). . Potential for increased nutrient levels: a) Upstream from Cahaba STP, especially if Gold-Kist Plant no upgraded, in natural pools or impounded areas with increased detention time and increased light level permitting nuisance algal blooms or spread of macrophytes. b) Downstream of Cahaba STP for similar reasons; light-filtering tree canopy may reduce impact.	. Minor increase in base flow in area of land disposal site. . Some reduction of nutrient inputs to the Cahaba River system from STP discharges. . Reduction in amount of STP effluent reaching the water supply.	. Increase in storage capacity. . Increased streamflow of Cahaba River.	. Increase in storage capacity. . Only plan to augment flow in upper reaches of the Cahaba River.	. Increased water quantity and quality by removing water supply intake from the Cahaba River and increasing its assimilative capacity.	. Increased water quality by removing water supply intake from the Cahaba River and increasing its assimilative capacity.	

TABLE AII-36 (Cont'd.)

SUMMARY OF SIGNIFICANT ENVIRONMENTAL IMPACTS

Environmental Factor	No Action	Cahaba	Upper Cahaba-Cahaba	Trussville-Cahaba	Overton-Cahaba	Patton Creek Upper Cahaba-Cahaba
Aquatic Life	. Existing aquatic habitat problems due to STP discharges, such as from the overloaded Patton Creek STP, will continue. . Continued eutrophication of Lakes Purdy and Paradise. . As the aquatic habitat continues to degrade, there will be an increased threat to the endangered goldline darter and Cahaba shiner.	. Decrease in eutrophication of Lakes Purdy and Paradise resulting in an improved aquatic environment of increased diversity. . Temporary loss of stream bottom habitat from erosion along 186,600 feet of interceptor and force main of which 2,550 feet crosses a streambed in 25 locations. . Long term, most improved habitat between Cahaba STP and Trussville (by all effluent entering Cahaba River south of the Cahaba STP) if Gold-Kist Plant is upgraded. . Disposal of all domestic wastewater of the study area through the Cahaba STP creates the potential for degraded aquatic habitat downstream of the plant. . The potential exists for the habitat of the goldline darter and the Cahaba shiner to be affected by nutrient loadings and residual chlorine from the Cahaba STP.	. Decrease in eutrophication of Lakes Purdy and Paradise resulting in an improved aquatic environment of increased diversity. . Temporary loss of stream bottom habitat from erosion along 113,125 feet of interceptor and force main of which 1,350 feet crosses a streambed in 14 locations. . General long-term potential for degraded aquatic habitats due to limited assimilative capacity of Cahaba River system. . Disposal of most of the study area's domestic wastewater through the Cahaba STP creates the potential for degraded aquatic habitat downstream of the plant. . The potential exists for the habitat of the goldline darter and the Cahaba shiner to be affected by nutrient loadings and residual chlorine from the Cahaba STP.	. Decrease in eutrophication of Lakes Purdy and Paradise resulting in an improved aquatic environment of increased diversity. . Temporary loss of stream bottom habitat from erosion along 120,475 feet of interceptor and force main of which 1,575 feet crosses a streambed in 15 locations. . General long-term potential for degraded aquatic habitats due to limited assimilative capacity of Cahaba River system. . Disposal of most of the study area's domestic wastewater through the Cahaba STP creates the potential for degraded aquatic habitat downstream of the plant. . The potential exists for the habitat of the goldline darter and the Cahaba shiner to be affected by nutrient loadings and residual chlorine from the Cahaba STP.	. Decrease in eutrophication of Lakes Purdy and Paradise resulting in an improved aquatic environment of increased diversity. . Temporary loss of stream bottom habitat from erosion along 118,650 feet of interceptor and force main of which 1,250 feet crosses a streambed in 15 locations. . General long-term potential for degraded aquatic habitats due to limited assimilative capacity of Cahaba River system. . Disposal of most of the study area's domestic wastewater through the Cahaba STP creates the potential for degraded aquatic habitat downstream of the plant. . The potential exists for the habitat of the goldline darter and the Cahaba shiner to be affected by nutrient loadings and residual chlorine from the Cahaba STP.	. Decrease in eutrophication of Lakes Purdy and Paradise resulting in an improved aquatic environment of increased diversity . Temporary loss of stream bottom habitat from erosion, the degree depending upon Patton Creek STP modifications: a) If Patton Creek STP discharges directly into Patton Creek: 123,125 feet of interceptor of which 1,350 feet crosses streams 14 times. b) If Patton Creek STP upgraded and discharges directly into Cahaba River: 135,200 feet of interceptor of which 1,425 feet crosses streams 15 times. c) If Patton Creek STP retained for primary treatment, with flow going to Cahaba STP: 113,125 feet of interceptor of which 1,350 feet crosses stream 11 times. . General long-term potential for degraded aquatic habitats due to limited assimilative capacity of Cahaba River system. . Disposal of most of the study area's domestic wastewater through the Cahaba STP creates the potential for degraded aquatic habitat downstream of the plant. . The potential exists for the habitat of the goldline darter and the Cahaba shiner to be affected by nutrient loadings and residual chlorine from the Cahaba STP.

TABLE AII-36 (Cont'd.)

SUMMARY OF SIGNIFICANT
ENVIRONMENTAL IMPACTS

Environmental Factor	Leeds-Trussville Cahaba	All Basic Alternatives Land Disposal	Lake Purdy	Black Creek	Lake Purdy Intake	Warrior River	Warrior River and Cahaba River
Aquatic Life	. Improved water quality and aquatic habitat in Lake Paradise; nutrients from Leeds STP could adversely affect Lake Purdy. . Temporary loss of stream bottom habitat from erosion along 54,975 feet of interceptor and force main of which 600 feet crosses the Cahaba River in 6 locations. . General long-term potential for degraded aquatic habitats due to limited assimilative capacity of Cahaba River system. . Disposal of most of the study area's domestic wastewater through the Cahaba STP creates the potential for degraded aquatic habitat downstream of the plant. . The potential exists for the habitat of the goldline darter and the Cahaba shiner to be affected by nutrient loadings and residual chlorine from the Cahaba STP.	. Effects varying with alternative a) Upper Cahaba-Cahaba: 15% of sewage effluent normally emptied into Cahaba River will be totally dispersed on land, resulting in improved water quality. b) Trussville-Cahaba: Force main will cross streambed in 4 locales; 7% of sewage effluent normally emptied into the Cahaba River will be totally dispersed on land resulting in a potential for improved water quality conditions. c) Overton-Cahaba: 17% of sewage effluent normally emptied into the Cahaba River will be totally diverted to land disposal resulting in a potential for improved water quality conditions. d) Upper Cahaba Cahaba Patton Creek: Same as Upper Cahaba Cahaba. e) Leeds Trussville Cahaba: 1) Leeds diversion to land treatment: 8% of sewage for land disposal. 2) Trussville diversion: 7% of sewage for land disposal.	. Increase littoral zone and resulting primary and secondary production. . Potential increase in hypolimnion (zone of eutrophication). . Increase flow restoration capabilities and potential aquatic diversity within the Cahaba River.	. Changing aquatic habitat from riverine to lacustrine environment. . Potential effect of mine drainage on aquatic life in reservoir.	. Potential fish kill from large draw-down causing artificial overturn. . Decrease in littoral zone. . Increased fish catches due to crowding at draw-down.	Increased assimilative capacity of the Cahaba River by its discontinued use as a source of municipal water by the City of Birmingham.	

E. IMPLEMENTABILITY EVALUATION

INTRODUCTION

This evaluation was conducted to determine the implementation potential of each wastewater alternative. A potential project may be the best engineering solution but may face serious problems which would make implementation infeasible. Therefore, it is important that implementation feasibility be considered as part of our overall evaluation process. This implementability evaluation was conducted by a team of planners, engineers, and environmental scientists.

EVALUATION CRITERIA AND PROCEDURES

In evaluating implementability, the following evaluation criteria were utilized:

1. Public Acceptability
2. Institutional and Management Considerations
3. Planning Flexibility

The implementability evaluation is presented in Chapter III, Table III-23 of the Draft Environmental Impact Statement. The table presents a matrix of the wastewater and water supply/augmentation alternatives in the Cahaba River Basin. For each alternative a score of 1-50 was used for the evaluation. The three separate criteria were then applied to each alternative and, based upon a qualitative evaluation, points were assigned to each alternative on the matrix. Within the maximum score of 50 points, each of the three evaluation criteria were assigned a maximum number of points that could be assigned to each individual criteria. For the purpose of the evaluation, the following points were assigned:

Public Acceptability	- 25 points
Institutional and Management Considerations	- 15 points
Planning Flexibility	- 10 points

F. COST EFFECTIVENESS ANALYSIS METHODOLOGY

INTRODUCTION

EPA requires that wastewater management alternatives be evaluated on the basis of cost effectiveness analysis. This analysis is a methodology for the selection of an alternative system which efficiently utilizes resources while minimizing adverse environmental and social impacts. The Cahaba River Basin EIS cost effectiveness analysis involves the evaluation of trade-offs among the monetary costs, environmental impacts, implementability, and operability of each alternative. The cost effectiveness analysis allows the comparison of the preceding evaluation factors on a common base so that each alternative may be shown on one matrix, represented by one alternative rating value. Because a project may create a wide range of impacts, the categories in which these impacts occur must be examined for relative importance. Weighting the categories allows those factors that are more significant to be represented more heavily than those that are less significant.

The cost effectivenss analysis methodology involved a numerical matrix that established ratings for each alternative. This rating system combines the effects of all the evaluation factors considered. Each of the four evaluation factors was assigned a total number of cost effective rating points and within each of the evaluation factors, the points were distributed into various subcategories. Within each alternative, the number of rating points was totaled and displayed in a matrix showing each water quality management system according to the wastewater treatment and conveyance configurations (Table AII-48).

METHODOLOGY

Each alternative wastewater management system was given a potential of 1000 cost effective rating points. A breakdown of these points according to evaluation factor and subcategory is found below:

EVALUATION FACTOR (Total Cost Effect. Rating Pts.)	COST ANALYSIS (350)	ENVIRONMENTAL IMPACT (350)	OPERABILITY (150)	IMPLEMENTABILITY (150)
Category	1. Present Worth (200)	1. Aquatic (175)		
	2. Local Annual Costs (150)	2. Terrestrial (75)		
		3. Manmade (100)		

After each of the four major evaluation factors and their subcategories were carefully reviewed and distributed evaluation scores or dollar values, they were analyzed to determine a function which would accurately translate the evaluation score/dollars into the cost effective rating points desired.

COST EVALUATION

The cost analysis was broken down into two subcategories: present worth and the local annual cost. The present worth analysis establishes a total cost value of the capital expenditures and operating costs of each alternative over the duration of the 18 year planning period ending in the year 2000 using an interest rate of 6.375%. The local annual costs reflect more closely the relative impacts of the alternatives on the systems owner, the Jefferson County Sanitation Department and its users.* It was determined that the rating function would inversely relate the project cost (dollars) to the rating point range. This would result in higher points for the lower priced alternatives.

The function developed to translate the costs into the rating points matched the midpoint for the range of costs to the midpoint for the range of rating points. This methodology resulted in the following functions for establishing cost-effectivenss point ratings for the two cost evaluation factors:

$$\text{PRESENT WORTH RATING} = \frac{3.87 \times 10^9}{\text{PRESENT WORTH (IN DOLLARS)}}$$

$$\text{LOCAL ANNUAL COST RATING} = \frac{2.06 \times 10^8}{\text{LOCAL ANNUAL COST (IN DOLLARS)}}$$

ENVIRONMENTAL EVALUATION

The environmental impact analysis, which is worth 350 points, utilized a variety of methodologies: open-celled narrative matrices, interaction matrices, and an ad hoc evaluation committee. The open-celled narrative matrix provides a cause-effect relationship between a list of environmental parameters and the proposed actions. The degree of impact-beneficial, neutral, or harmful - was quantified where possible. (The environmental impacts were broken into the three categories: aquatic environment worth 175 points, terrestrial environment worth 75 points, and manmade environment worth 100 points). The ad hoc committee assigned weighted values of relative importance to each environmental parameter within the three categories. The impacts were determined to be beneficial (positive), neutral (zero), or harmful (negative) and a magnitude from 0 to 4 was assigned to each cell. This quantified value multiplied by the weight for each parameter yielded a weighted score. These weighted scores were totaled to obtain a grand total for impacts caused by each alternative.

For each category, the impacts were examined to determine the maximum possible range of scores. An amount was added to adjust each category range to bring all scores to positive values (≥ 0). This positive range was then adjusted to the maximum available rating range by a factor to match the scores to the rating points. This resulted in the following three functions:

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*A more in-depth discussion of this aspect is found in Section B of this appendix.

Terrestrial Impact Rating = (Impact Evaluation Score + 56) (1.5)

Aquatic Impact Rating = (Impact Evaluation Score + 40) (2.3)

Manmade Impact Rating = (Impact Evaluation Score + 68) (.833)

IMPLEMENTABILITY EVALUATION

The implementability evaluation which is worth 150 points considers the question of alternative implementability in view of both the public and political realities within the study area. A more in-depth discussion of implementability can be found in Section E of this appendix. The three parameters evaluated were public acceptance, institutional considerations, and planning flexibility. The actual points were computed using a function which matched the midpoint of the evaluation score to the midpoint of the rating points to obtain a factor. This factor multiplied times the evaluation score yielded the rating points:

2.30 x IMPLEMENTABILITY EVALUATION SCORE = IMPLEMENTABILITY RATING

OPERABILITY EVALUATION

The final evaluation, also worth 150 points, is for the operability of the facilities. The operability involves three general parameters: reliability of treatment, flexibility of operation, and facilities maintainability. The operability of the facilities is discussed in more detail in Section C of this appendix. These areas were considered for each of the wastewater facilities alternatives and comparative ratings were established for each of the parameters. The actual points were determined using the same formula which was used for the implementability factor. By matching the midpoint of the evaluation scores to the midpoint of the rating points, a factor was obtained to multiply by the evaluation score to get the rating points:

2.54 x OPERABILITY EVALUATION SCORE = OPERABILITY RATING POINTS

APPLICATION

The cost-effectivenss analysis was performed on each of the wastewater management system alternatives using the above described methodology. Tables AII-37 through AII-47 present the results of the individual ratings for each evaluation factor applied to the alternative systems. These cost-effectiveness ratings are summarized for all alternatives in Table AII-48.

TABLE AII-37

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR OVERTON-CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	108	129	112	111	112	79
Local Annual Costs (150)	110	132	95	93	89	52
ENVIRONMENTAL IMPACTS						
Aquatic (175)	122	122	161	161	161	138
Terrestrial (75)	36	36	24	24	24	11
Manmade (100)	53	53	53	56	53	50
IMPLEMENTATION (150)	62	62	46	58	49	42
OPERABILITY (150)	76	86	81	84	92	84
TOTAL	567	620	572	587	580	456

TABLE AII-38

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR UPPER CAHABA - CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	111	134	115	114	116	81
Local Annual Costs (150)	117	141	99	98	93	54
ENVIRONMENTAL IMPACTS						
Aquatic (175)	122	122	161	161	161	138
Terrestrial (75)	36	36	24	24	24	11
Manmade (100)	53	53	53	56	53	50
IMPLEMENTATION (150)	81	81	69	76	72	65
OPERABILITY (150)	76	86	81	84	92	84
TOTAL	596	653	602	613	611	483

TABLE AII-39

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR LEEDS (L. CAHABA R.) TRUSSVILLE-CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	125	153	129	128	130	88
Local Annual Costs (150)	120	145	101	100	95	54
ENVIRONMENTAL IMPACTS						
Aquatic (175)	106	106	161	161	161	131
Terrestrial (75)	56	56	30	33	30	3
Manmade (100)	53	53	53	56	53	60
IMPLEMENTATION (150)	109	109	95	102	97	90
OPERABILITY (150)	64	74	69	71	79	71
TOTAL	633	696	638	651	645	497

TABLE AII-40

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR LEEDS (CAHABA R.) TRUSSVILLE-CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	125	154	130	129	131	88
Local Annual Costs (150)	120	145	102	100	95	54
ENVIRONMENTAL IMPACTS						
Aquatic (175)	115	115	161	161	161	140
Terrestrial (75)	45	45	24	24	24	14
Manmade (100)	53	53	53	56	53	60
IMPLEMENTATION (150)	109	109	95	102	97	90
OPERABILITY (150)	64	74	69	71	79	71
TOTAL	631	695	634	643	640	517

TABLE AII-41

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR TRUSSVILLE - CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	109	132	114	113	115	80
Local Annual Costs (150)	113	137	98	96	92	53
ENVIRONMENTAL IMPACTS						
Aquatic (175)	122	122	161	161	161	138
Terrestrial (75)	36	36	24	24	24	11
Manmade (100)	53	53	53	56	53	50
IMPLEMENTATION (150)	104	104	90	99	92	85
OPERABILITY (150)	71	81	76	79	86	79
TOTAL	608	665	616	628	623	496

TABLE AII- 42

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	103	123	107	107	108	77
Local Annual Costs (150)	110	133	95	94	90	53
ENVIRONMENTAL IMPACTS						
Aquatic (175)	122	122	161	161	161	140
Terrestrial (75)	26	26	17	23	17	8
Manmade (100)	53	53	53	56	53	50
IMPLEMENTATION (150)	74	74	62	72	65	58
OPERABILITY (150)	71	81	76	79	89	81
TOTAL	559	612	571	592	583	467

TABLE AII- 43

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR PATTON CREEK* - UPPER CAHABA - CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	105	119	104	103	103	74
Local Annual Costs (150)	112	125	91	90	84	51
ENVIRONMENTAL IMPACTS						
Aquatic (175)	115	115	161	161	161	131
Terrestrial (75)	39	39	26	26	26	8
Manmade (100)	53	53	53	56	53	50
IMPLEMENTATION (150)	69	69	58	65	60	53
OPERABILITY (150)	59	69	64	66	74	66
TOTAL	552	589	557	567	561	433

*via Patton Creek

TABLE AII- 44

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR PATTON CREEK* - UPPER CAHABA - CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	114	130	112	112	111	78
Local Annual Costs (150)	122	139	98	97	90	53
ENVIRONMENTAL IMPACTS						
Aquatic (175)	122	122	161	161	161	138
Terrestrial (75)	32	32	24	24	24	15
Manmade (100)	53	53	53	56	53	50
IMPLEMENTATION (150)	99	99	85	92	88	81
OPERABILITY (150)	64	74	69	71	79	71
TOTAL	606	649	602	613	606	486

*via Cahaba River

TABLE AII-45

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR UPPER CAHABA - CAHABA - PATTON CREEK

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	113	137	117	116	118	82
Local Annual Costs (150)	114	137	97	96	91	53
ENVIRONMENTAL IMPACTS						
Aquatic (175)	122	122	161	161	161	138
Terrestrial (75)	36	36	24	24	24	11
Manmade (100)	53	53	53	56	53	50
IMPLEMENTATION (150)	97	97	83	90	85	79
OPERABILITY (150)	64	74	69	71	79	71
TOTAL	599	656	604	614	611	484

* Pretreatment

TABLE AII-46

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR UPPER CAHABA - SPRAY IRRIGATION - CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	104	124	108	107	108	77
Local Annual Costs (150)	100	127	92	91	86	51
ENVIRONMENTAL IMPACTS						
Aquatic (175)	129	129	161	161	161	145
Terrestrial (75)	30	30	18	18	18	17
Manmade (100)	53	53	53	56	53	50
IMPLEMENTATION (150)	81	81	67	74	69	62
OPERABILITY (150)	69	79	74	76	84	76
TOTAL	566	623	573	583	579	478

TABLE AII-47

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING FOR LEEDS* - TRUSSVILLE - CAHABA

WATER QUALITY MANAGEMENT SYSTEM

Rating Factor	No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Crk. Res. Treatment Level 2	Lake Purdy Expans. Treatment Level 2	Big Black Creek Basin Res. Treatment Level 1	Big Black Creek Basin Res. Water Intake Treatment Level 1
COSTS						
Present Worth (200)	119	145	123	122	124	85
Local Annual Costs (150)	117	141	100	98	93	54
ENVIRONMENTAL IMPACTS						
Aquatic (175)	113	113	161	161	161	138
Terrestrial (75)	50	50	24	27	24	9
Manmade (100)	53	53	53	56	53	60
IMPLEMENTATION (150)	88	88	76	81	79	72
OPERABILITY (150)	59	69	64	66	74	66
TOTAL	599	659	601	611	608	484

* Spray Irrigation

TABLE AII-48

CAHABA RIVER BASIN EIS
COST EFFECTIVENESS RATING OF ALTERNATIVES

Wastewater Treatment and Conveyance Configuration	WATER QUALITY MANAGEMENT SYSTEMS No Augmentation Treatment Level 3	No Augmentation Treatment Level 2	Big Black Creek Reservoir Treatment Level 2	Lake Purdy Expansion Treatment Level 2	Big Black Creek Basin Reservoir Treatment Level 1	Big Black Creek Basin Res. Relocate Water Intake Treatment Level 1
1. Overton-Cahaba	567	620	572	587	580	456
2. Upper Cahaba-Cahaba	596	653	602	613	611	483
3. Leeds via Little Cahaba River-Trussville-Cahaba	633	696	638	651	645	497
4. Leeds via Cahaba River-Trussville-Cahaba	631	695	634	643	640	517
5. Trussville-Cahaba	608	665	616	628	623	496
6. Cahaba	559	612	571	592	583	467
7. Patton Creek via Patton Creek-Upper Cahaba-Cahaba	552	589	557	567	561	433
8. Patton Creek via Cahaba River-Upper Cahaba-Cahaba	606	649	602	613	606	486
9. Upper Cahaba-Cahaba with Patton Creek Pretreatment	599	656	604	614	611	484
10. Upper Cahaba-Spray Irrigation-Cahaba	566	623	573	583	579	478
11. Leeds Spray Irrigation-Trussville-Cahaba	599	659	601	611	608	484

G. EVALUATION OF NO-ACTION ALTERNATIVE

The no-action alternative represents the option to provide no further federal funding towards the construction of wastewater facilities in the Cahaba River Basin. This alternative presents a scenario that would involve only state, local or private investment in the construction of wastewater facilities. Under a no-action alternative the following concepts would prevail:

1. Different population.
2. Different land use.
3. Additional on-lot disposal systems.
4. More package plants.
5. No expansion or upgrading of County facilities or I/I correction.
6. Bring existing plants into compliance with treatment requirements.
   (a) Divert treatment plant effluent from Patton Creek to Cahaba River.
   (b) Add new package plants.
   (c) Recondition old package plants with present owners continuing operation.
   (d) Recondition old on-lot systems.

The no-action alternative has been treated similarly to other alternatives which call for a specific wastewater action. Under the no-action alternative, growth would continue to occur. However, private, local or state investment would be required for wastewater facilities rather than reliance upon federal grants. Under the no-action alternative we have estimated population projections under such a scenario. In addition, a cost evaluation has been made of the wastewater facility alternatives under the no-action alternative. This cost evaluation is presented in Appendix II, B. Cost Evaluation Methodology.

A major component of the no-action alternative is the development of population projections to fit the no-action scenario. Under a no-action development alternative there are three major components which were utilized to develop the no-action alternative. These components are: infill population; development tract population; and scatter population.

INFILL POPULATION

Infill population is caused by something we have referred to as the "infill process". Infill developments are generally associated with individual construction activities in neighborhoods which are already substantially developed but which have not yet been "built out". Many established residential neighborhoods often have a small number of available building lots usually totalling between 10 and 20 percent of the maximum number of lots. Such areas may have posed special problems in the past related to ownership, construction and investments opportunities which have prevented their improvements.

Another area where "infill" development is likely to take place occurs in between two or more large scale suburban developments. Such development is represented by the conversion of farms or empty areas. This conversion of unimproved lands into buildable lots often takes place as the selling of individual lots by land owners who may have elected to hold out in anticipation of greater capital gain or for purposes of reducing capital gains tax or inheritance taxes. This process results in a filling in of the remaining residential lots by builders or owners who in turn are capitalizing on the development of the infrastructure of a growing community.

Two characteristics identify both types of infill development. First, it is a relatively slow process and secondly, it is an activity engaged in by local and generally small construction firms who can better take advantage of the local real estate market.

The process of determining infill populations began with the delineation of so-called communities within the study area. These areas included the Leeds area, Trussville area and the large area in the basin encompassing Hoover-Vestavia Hills-Mountain Brook areas. These were the communities under our criteria that were defined as areas where "infill development" and population growth would occur under a no-action alternative. These developments could utilize any excess capacity in the present sewer system, or install on-lot systems or package plants. All tract sizes were less than 70 acres except for several tracts in the Leeds and Trussville areas. Larger tracts would be considered under the development tract populations to be considered later in this section. For each tract, we considered the net developable acreage for each tract as 75% of the total tract size. This was assuming that 25% of the tract would be used for transportation network, utility rights-of-way, recreation, and other public purposes. If the land was generally suitable, meaning that it could easily accommodate on-lot sewage disposal, it was determined that a density of 2 dwelling units/acre could be achieved. If the land was only moderately suitable because of soils or slope limitations then a density of 1 dwelling unit/two acres would be achieved. From this was developed the number of potential dwelling units that could be supported by the various tracts. Population estimates for each tract were then developed based upon a factor of 3.1 persons/dwelling unit. This figure is the average figure for the Birmingham SMSA. Table AII-49 presents the infill population projections developed for the no-action alternative. The year 2000 projection for the basin is 7,164 persons from infill population.

TABLE AII-49
POTENTIAL DEVELOPMENT WITHIN COMMUNITY BOUNDARIES
(INFILL POPULATIONS)

	Size				
Tract	Total Size (Acres)	General Suitability Total/Net AC / AC	Moderate Suitability Total/Net AC / AC	Potential Dwelling Units	Estimated Population (3.1)
1	60	60/45	0/0	90	279
2	30	30/24	0/0	48	149
5	30	30/22	0/0	44	136
8	50	50/37	0/0	74	229
9	60	60/45	0/0	90	279
11	40	40/30	0/0	60	186
12	40	40/30	0/0	60	186
14	60	60/45	0/0	90	279
15	20	0/0	20/15	8	25
17	10	10/7	0/0	14	43
20	30	30/22	0/0	44	136
21	70	70/52	0/0	104	322
29	50	40/30	10/7	64	198
32	50	0/0	50/37	19	59
33	20	0/0	20/15	8	25
34	50	50/37	0/0	74	229
35	40	40/30	0/0	60	186
37	40	0/0	40/30	15	47
Total 18	750	610/456	140/104	966	2,993

TABLE AII-49 (Cont'd.)
POTENTIAL DEVELOPMENT WITHIN COMMUNITY BOUNDARIES (INFILL POPULATIONS)

		Size			
Tract	Total Size (Acres)	General Suitability Total/Net AC / AC	Moderate Suitability Total/Net AC / AC	Potential Dwelling Units	Estimated Population (3.1)
		Trussville Area			
40	60	60/45	0/0	90	279
41	50	50/37	0/0	74	229
42	180	180/135	0/0	270	837
43	50	50/37	0/0	74	229
45	30	30/22	0/0	44	136
Total 5	360	370/276	0/0	552	1,710
		Leeds Area			
46	320	320/240	0/0	480	1,488
47	120	120/90	0/0	180	558
49	70	70/52	0/0	104	322
50	20	20/15	0/0	30	93
4	530	530/347	0/0	794	2,461
Totals 27	1,650	1510/1129	140/104	2,312	7,164

Source: Gannett Fleming Corddry and Carpenter, Inc.

DEVELOPMENT TRACT POPULATION

The second component of the no-action population estimate is the development tract population. These are large tracts of land which have been assembled by developers and are either presently under construction or planned for construction in the near future. The Birmingham Chamber of Commerce provided data on a wide range of large scale residential developments proposed in the study area. The Chamber classified these developments as: (1) under construction; (2) looks strong; and (3) probable in time.

Under a no-action scenario many of the planned, large-scale developments will not be built because of the unavailability of public sewerage. Therefore, a screening process was developed to determine which of the large developments would continue to be built under a no-action scenario. First, only developments classified as "under construction" or "looks strong" were considered. Second, most developments of less than 50 acres were screened since it might not be profitable to a developer to install a sewage collection system and package plant to serve the smaller developments. Third, proximity to the Cahaba River or Little Cahaba River was also considered since the cost of constructing a long outfall would cause exhorbitant user charges. A cost curve was established based upon distance from the Cahaba or Little Cahaba. If the cost curve indicated that a proposed development would have a charge of greater than $300/dwelling unit for sewer usage because of the distance from either the Cahaba or Little Cahaba, then this was also used as a screening factor for any of the larger developments.

This screening process of development tracts basin provided 15 developments tracts ranging in size from 57 to 3,000 acres. Based upon the data in Table AII-50, it is estimated that development tracts will account for a population growth of 30,631 persons throughout the basin by the year 2000. This accounts for most of the population growth that will occur in the basin under the no-action scenario. This assumes that private investment will continue their interest in the basin without the provision of public wastewater facilities. This would require the use of privately owned package plants for each development or the extensive use of on-lot disposal systems.

SCATTER POPULATION

A second component of the small scale suburbanization process consists of "scatter development". This component is by far the smallest except in those areas which have no existing urban or suburban development. The scattered development refers to the construction activity (almost always in the form of single family units) which takes place throughout a rural area and which is neither influenced by large scale development nor infill. This form of development is extremely difficult to predict since the factors influencing it are unrelated to rational or even political, social, or economic factors. Consequently, the scatter component of residential activity has been allocated on the basis of the size of areas which are not environmentally restricted and in which urban and suburban development is low or absent. The allocation of scatter population was influenced by two additional factors, namely, the region's "suitability" from a residential point of view and its accessibility.

TABLE AII-50
DEVELOPMENT TRACTS IN THE BASIN

Tract	Size		Existing Dwelling Units	Future Dwelling Units	Total Dwelling Units	Projected Population (3.1xD.U.)
	Total	Net				
1	3,000	1,740	1,350	2,130	3,480	10,788
2	855	290	200	380	580	1,798
8	98	62	200	--	200	620
10	103	53	210	--	210	651
18	1,300	816	296	1,336	1,632	5,059
20	400	244	300	188	488	1,512
24	57	41	100	--	100	310
38	250	0	200	--	200	620
41	80	32	174	--	174	539
46	150	72	62	82	144	446
47	1,400	976	300	1,652	1,952	6,051
52	207	90	0	180	180	558
66	129	84	250	--	250	775
67	114	74	--	148	148	458
68	60	40	144	--	144	446
Total 15	8,203	4,614	12,116	19,507	9,882	30,631

Source: Gannett Fleming Corddry and Carpenter, Inc.

Since few areas have been identified as suitable for large scale residential development in the northern sector, an attempt was made to factor in such a component into subsequent suballocation procedures. This was projected to occur particularly towards the end of the planning period.

Table AII-51 provides scatter population projection at 5 year increments until the year 2000. A total scatter population of 4,901 persons is projected for the basin.

TOTAL NO-ACTION POPULATION PROJECTIONS

Table AII-52 provides a summary of the basin population under a no-action alternative. Under no-action, a population increase of 42,690 persons or a total 2000 population of 135,430 is estimated. This estimate is largely dependent upon the action of major developers who would be faced with the prospect of no public wastewater facilities. An interesting point about the no-action population estimate is that it is only 2,779 persons less than the 134,209 that are projected under the unconstrained conditions which foresee considerable expansion of wastewater facilities.

POPULATION DISAGGREGATION TO SUBWATERSHED

The no-action population projections were disaggregated to each subwatershed in order to compare no-action and proposed action population projections by subwatershed. The no-action population projections were disaggregated in the following manner:

1. Infill population was assigned to the subwatershed in which the infill tract is located.
2. Development tract population was assigned to the subwatershed in which the tract is located.
3. Scatter population was distributed on basis of the size of the subwatershed.

TABLE AII-51
SCATTER POPULATION PROJECTIONS

	1980	1985	1990	1995	2000	Total
Northern Sector	1,723	650	400	400	400	3,573
Central Sector	204	38	71	220	179	712
Southern Sector	553	35	28	-	-	616
Totals	2,480	723	499	620	579	4,901

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-52
NO-ACTION POPULATION SUMMARY

Infill Population		Development Tract Population	Scatter Population		Total No-Action Population Increase
Southern Sector	2,993		Northern Sector	3,573	
Trussville	1,710		Central Sector	712	
Leeds	2,461		Southern Sector	616	
Total	7,163	30,631		4,901	42,696

No-Action Population

1975	2000	Percent Change in Population
92,734	135,340	46.0

Unconstrained Population

1975	2000	Percent Change in Population
92,734	138,209	49.0

Source: Gannett Fleming Corddry and Carpenter, Inc.

H. ESTIMATION OF SEWERED POPULATION BY SUBDRAINAGE BASIN

As a basis for estimating future wastewater flows in the study area, use has been made of the subdrainage basin population projections which have been developed for the Cahaba Basin, as presented in Table III-25. From these population projections, future residential and commercial wastewater flows have been estimated for each alternative utilizing data on present day per capita water consumption rates. Potential areas to which sewer service should be provided have been determined with consideration given to factors such as existing and future population densities, location of existing package treatment plants to be phased out, the existing and proposed transportation network, location of proposed residential development, soil suitabilities for on-lot disposal, and areas of environmental sensitivity. Incorporation of the phasing concept into the various alternatives is especially appropriate for the Cahaba Basin in that it facilitates the adjustment of the second-phase wastewater program should future needs vary from current projections.

The following tables present the percent sewered estimates, on a subdrainage basin level, for each basic wastewater management alternative formulated for evaluation.

TABLE AII-53

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
OVERTON-CAHABA

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
A	0	0	0	0	0	0	0
B-N	50	60	65	65	65	70	70
B-C$^{(upper)}$	0	0	0	5	10	15	20
B-C$^{(lower)}$	0	0	0	0	25	50	50
B-S	15	25	50	60	70	80	90
C	0	0	0	25	30	35	40
D	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
F	0	0	0	0	0	0	0
G	0	0	0	50	55	55	60
H	40	55	60	90	90	90	90
I	0	0	0	0	5	10	20
J	0	0	0	40	55	65	70
K	0	0	0	0	25	45	50
L	40	65	65	75	80	85	90
M	0	0	0	35	60	70	75
N	60	55	65	75	80	85	90
O	0	0	0	0	30	50	70

TABLE AII-53

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
OVERTON-CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
P	0	0	0	0	0	0	0
Q	0	0	0	0	50	75	75
R	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
T	0	0	0	0	50	90	90
U	0	0	0	0	0	0	0
V	0	0	0	0	0	0	0
W	55	60	65	80	85	90	90
X	0	0	25	50	60	70	80
Y	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0
AA	0	0	0	0	0	0	0
BB	0	0	0	0	0	0	0
CC	0	0	0	60	65	70	75
DD	55	55	65	70	75	80	90
EE	45	45	60	75	80	85	90
FF	0	0	95	95	95	95	95

TABLE AII-

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
OVERTON-CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
GG	0	75	80	85	90	95	95
HH	0	0	0	0	0	0	0
II	0	0	75	80	80	85	85
JJ	0	0	0	0	0	0	0

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-54

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
UPPER CAHABA - CAHABA

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
A	0	0	0	0	0	0	0
B-N	50	60	65	65	65	70	70
B-C(Upper)	0	0	0	5	10	15	20
B-C(Lower)	0	0	0	0	25	50	50
B-S	15	25	50	60	70	80	90
C	0	0	0	25	30	35	40
D	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
F	0	0	0	0	0	0	0
G	0	0	0	50	55	55	60
H	40	55	60	90	90	90	90
I	0	0	0	0	0	0	0
J	0	0	0	0	0	0	0
K	0	0	0	0	0	0	0
L	40	65	65	75	80	85	90
M	0	0	0	0	0	0	0
N	60	55	65	75	80	85	90
O	0	0	0	0	0	0	0

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
UPPER CAHABA - CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
P	0	0	0	0	0	0	0
Q	0	0	0	0	50	75	75
R	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
T	0	0	0	0	50	90	90
U	0	0	0	0	0	0	0
V	0	0	0	0	0	0	0
W	55	60	65	80	85	90	90
X	0	0	25	50	60	70	80
Y	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0
AA	0	0	0	0	0	0	0
BB	0	0	0	0	0	0	0
CC	0	0	0	60	65	70	75
DD	55	55	65	70	75	80	90
EE	45	45	60	75	80	85	90
FF	0	0	95	95	95	95	95

TABLE AII-54

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
UPPER CAHABA - CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
GG	0	75	80	85	90	95	95
HH	0	0	0	0	0	0	0
II	0	0	75	80	80	85	85
JJ	0	0	0	0	0	0	0

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-55

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION

LEEDS - TRUSSVILLE - CAHABA

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
A	0	0	0	0	0	0	0
B-N	50	60	65	65	65	70	70
B-C$^{(Upper)}$	0	0	0	0	0	0	0
B-C$^{(Lower)}$	0	0	0	0	25	50	50
B-S	15	25	50	60	70	80	90
C	0	0	0	25	30	35	40
D	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
F	0	0	0	0	0	0	0
G	0	0	0	50	55	55	60
H	40	55	60	90	90	90	90
I	0	0	0	0	0	0	0
J	0	0	0	0	0	0	0
K	0	0	0	0	0	0	0
L	40	65	65	75	80	85	90
M	0	0	0	0	0	0	0
N	60	55	65	75	80	85	90
O	0	0	0	0	0	0	0

TABLE AII-55

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
LEEDS - TRUSSVILLE - CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
P	0	0	0	0	0	0	0
Q	0	0	0	0	50	75	75
R	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
T	0	0	0	0	50	90	90
U	0	0	0	0	0	0	0
V	0	0	0	0	0	0	0
W	55	60	65	80	85	90	90
X	0	0	25	50	60	70	80
Y	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0
AA	0	0	0	0	0	0	0
BB	0	0	0	0	0	0	0
CC	0	0	0	60	65	70	75
DD	55	55	65	70	75	80	90
EE	45	45	60	75	80	85	90
FF	0	0	95	95	95	95	95

TABLE AII-55

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
LEEDS - TRUSSVILLE - CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
GG	0	75	80	85	90	95	95
HH	0	0	0	0	0	0	0
II	0	0	75	80	80	85	85
JJ	0	0	0	0	0	0	0

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABLE AII-56

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
TRUSSVILLE - CAHABA

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
A	0	0	0	0	0	0	0
B-N	50	60	65	65	65	70	70
B-C (Upper)	0	0	0	5	10	15	20
B-C (Lower)	0	0	0	0	25	50	50
B-S	15	25	50	60	70	80	90
C	0	0	0	25	30	35	40
D	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
F	0	0	0	0	0	0	0
G	0	0	0	50	55	55	60
H	40	55	60	90	90	90	90
I	0	0	0	0	5	10	20
J	0	0	0	40	55	65	70
K	0	0	0	0	25	45	50
L	40	65	65	75	80	85	90
M	0	0	0	35	60	70	75
N	60	55	65	75	80	85	90
O	0	0	0	0	30	50	70

TABLE AII-36

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
TRUSSVILLE - CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
P	0	0	0	0	0	0	0
Q	0	0	0	0	50	75	75
R	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
T	0	0	0	0	50	90	90
U	0	0	0	0	0	0	0
V	0	0	0	0	0	0	0
W	55	60	65	80	85	90	90
X	0	0	25	50	60	70	80
Y	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0
AA	0	0	0	0	0	0	0
BB	0	0	0	0	0	0	0
CC	0	0	0	60	65	70	75
DD	55	55	65	70	75	80	90
EE	45	45	60	75	80	85	90
FF	0	0	95	95	95	95	95

TABLE AII-56

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
TRUSSVILLE - CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
GG	0	75	80	85	90	95	95
HH	0	0	0	0	0	0	0
II	0	0	75	80	80	85	85
JJ	0	0	0	0	0	0	0

Source: Gannett Fleming Corddry and Carpenter, Inc.

TABL[illegible] AII-57

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
CAHABA

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
A	0	0	0	0	0	0	0
B-N	50	60	65	65	65	70	70
B-C$^{(upper)}$	0	0	0	5	10	15	20
B-C$^{(lower)}$	0	0	0	0	25	50	50
B-S	15	25	50	60	70	80	90
C	0	0	0	25	30	35	40
D	0	0	0	0	0	0	0
E	0	0	0	0	0	0	0
F	0	0	0	0	0	0	0
G	0	0	0	50	55	55	60
H	40	55	60	90	90	90	90
I	0	0	0	0	5	10	20
J	0	0	0	40	55	65	70
K	0	0	0	0	25	45	50
L	40	65	65	75	80	85	90
M	0	0	0	35	60	70	75
N	60	55	65	75	80	85	90
O	0	0	0	0	30	50	70

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
P	0	0	0	0	0	0	0
Q	0	0	0	0	50	75	75
R	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
T	0	0	0	0	50	90	90
U	0	0	0	0	0	0	0
V	0	0	0	0	0	0	0
W	55	60	65	80	85	90	90
X	0	0	25	50	60	70	80
Y	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0
AA	0	0	0	0	0	0	0
BB	0	0	0	0	0	0	0
CC	0	0	0	60	65	70	75
DD	55	55	65	70	75	80	90
EE	45	45	60	75	80	85	90
FF	0	0	95	95	95	95	95

TABLE AII-57

CAHABA RIVER BASIN
ENVIRONMENTAL IMPACT STATEMENT
PERCENT SEWERED POPULATION
CAHABA (Cont'd)

SUB-DRAINAGE BASIN	1975	1980	1983	1985	1990	1995	2000
GG	0	75	80	85	90	95	95
HH	0	0	0	0	0	0	0
II	0	0	75	80	80	85	85
JJ	0	0	0	0	0	0	0

Source: Gannett Fleming, Corddry and Carpenter, Inc.

I. NON-POINT SOURCE POLLUTION ANALYSIS

INTRODUCTION

As municipal and industrial wastewaters in the study area become better controlled by improved collection and treatment, non-point sources may produce a larger and more significant proportion of organic wastes, suspended solids, nutrients, grease, oils and other pollutants entering receiving waters. Nonpoint source pollution may increase as as area becomes more developed and in some watersheds can become the dominant source of water pollution. In addition, as the land uses in a developing area changes from rural to suburban or urban, the nature of the pollutants washed off into surface waters will change.

Non-point source pollution includes the transport to surface water by rainfall-runoff and to groundwater by rainfall-infiltration of various contaminants from streets and parking lots, industrial plant sites, solid waste disposal sites, agricultural areas, mining sites, and other land uses and activities. The general pollution potentials of major non-point sources in the study area are shown in Table AII-58.

Increases in residential, commercial, and industrial acreage and the associated land used for transportation corridors will probably cause the most significant changes in non-point source pollution in the study area. Fertilizers, weedkillers and other chemicals are found in runoff from residential areas. The characteristics of runoff from commercial and industrial areas depend upon the specific uses to which the land is put, but generally will include sizable concentrations of organics, oil, and grease. Automobile oil and exhaust deposits on road surfaces can be washed off into streams and lakes during storms.

Non-point source pollutants from agricultural areas include suspended solids, oxygen-demanding compounds, nutrients, pesticides, and herbicides. Runoff from logging activities in forested areas can carry large amounts of suspended solids and also some organics and nutrients. Active mining operations can result in heavy metals and huge amounts of sediment being washed into surface waters by storms. Also, runoff from coal-mining is generally acidic in nature. Solid waste disposal in landfills can be a non-point source of both groundwater and surface water pollution. In addition to contaminants washed off the surface of landfills, rainfall percolating through landfills produces leachate containing organics, nutrients, heavy metals, and pathogens.

Short-term non-point source problems may result from construction activities which remove natural vegetation and cause erosion and transport of sediment to receiving waters. Spills of various chemicals, particularly at industrial sites, may be another temporary non-point source of pollution.

In addition to land use, several factors affect the characteristics of rainfall-runoff reaching receiving waters, including intensity and duration of particular storm events, time between storms, drainage characteristics

TABLE AII-58
NONPOINT SOURCE POLLUTION CHARACTERISTICS

Category	Specific Runoff Source	General Pollution Potential
Urban	Industrial/Commercial Areas Residential Areas Streets and Highways	Primarily sediments, organics, pathogens, oil, grease, and some nutrients.
Nonurban	Agricultural Lands Forests	Primarily sediments, nutrients, pesticides, herbicides, pathogens, and some organics
Other	Mining Construction Solid Waste Disposal Pollutant Spills	Wide variety of contaminants ranging from metals to exotic chemicals

Source: Gannett Fleming Corddry and Carpenter, Inc.

of an area, and pollutant source control measures such as street cleaning. Because of the large number of variables, many of which cannot be accurately quantified, meaningful analysis of non-point source pollution is difficult without an extensive site-specific, storm-related water quality and quantity data base. No such data are currently available for the study area. However, some general water quality information from studies of areas similar to Birmingham is available and can be used to draw some conclusions about the Cahaba River Basin. Such information must be utilized cautiously due to the variability of non-point source pollution characteristics from site to site.

For the first flush of a typical storm event, the range of residential and industrial/commercial pollutant loadings to be expected is shown in Table AII-59. These pollutant loadings will, on the average, result in stormwater concentrations similar to those shown in Table AII-60.

The land use changes projected for the study area will affect the quantity as well as the quality of stormwater runoff. Increased urbanization will result in larger areas covered with impervious surfaces, causing increased runoff of rainfall and decreased recharge of aquifers. Also, runoff will be concentrated and reach streams more quickly in urbanized areas. Impacts on the hydrology of the study area have been discussed in Chapter V of the EIS.

PROJECTED LAND USE

A comparison of existing land use and projections of future land use indicates residential developments will consume an additional twenty-two square miles by the year 2000, resulting in approximately twenty percent of the land in the study area being in the residential land use category. Approximately four square miles of new industrial and commercial developments are also projected. Some of this new development is projected to occur on land currently used for agriculture, but most will occur on forested and undeveloped lands.

Residential, industrial and commercial developments are presently concentrated in the lower portion of the study area and around Leeds and Trussville. Table AII-61, which summarizes existing land use, shows this pattern. Growth in the study area is projected to occur primarily around these existing cores of development. Projected land use for the year 2000 is shown in Table AII-62.

MODELING NON-POINT SOURCE POLLUTION

To aid in the identification of potential non-point source pollution problems in the study area, two computer models developed by the Surveillance and Analysis Division of the EPA, Region IV were used. Evaluation of pollutant loadings from residential, commercial, and industrial areas during a selected storm event was performed using the computer model EPAURA. Runoff of pollutants from agricultural and undeveloped areas was analyzed using EPARRB, a model designed to assess non-point source problems in rural areas.

TABLE AII-59
URBAN NON-POINT SOURCE LOADS FOR A TYPICAL STORM EVENT

Parameter	Residential Load Per Curb Mile	Industrial/Commercial Load Per Acre of Impervious Surface
BOD_5 (lbs.)	1.9 to 61	0.9 to 29
COD (lbs.)	13 to 400	6 to 126
Total Solids (lbs.)	330 to 6000	200 to 2439
Kjel. Nitrogen (lbs.)	0.5 to 2.9	0.5 to 4.4
NO_3-N (lbs.)	0.01 to 3.3	0.01 to 1.4
Total Phosphates (lbs.)	0.2 to 4.5	0.01 to 1.4
Lead (lbs.)	0.03 to 1.9	0.02 to 0.8
Total Coliforms (MPN)	3.2×10^{10} to 17×10^{10}	-
Fecal Coliforms (MPN)	7×10^{6} to 3.1×10^{10}	-

Source: True, Howard A., "Non-Point Assessment Processes", April, 1976, unpublished, taken from Sartor, J. D. and G. B. Boyd, "Water Pollution Aspects of Street Surface Contaminants", EPA-R2-72-081, November, 1972.

TABLE AII-60
CHARACTERISTICS OF URBAN STORMWATER

Parameter	Concentration Range
BOD_5	1 to 700 mg/1
COD	5 to 3,100 mg/1
Total Suspended Solids	2 to 11,000 mg/1
Total Solids	450 to 15,000 mg/1
Organic Nitrogen	0.1 to 16 mg/1
NH_3-N	0.1 to 2.5 mg/1
Total Phosphates	0.1 to 130 mg/1
Chlorides	2 to 25,000 mg/1
Oils	0 to 110 mg/1
Phenols	0 to 0.2 mg/1
Lead	0 to 1.9 mg/1
Total Coliforms	200 to 150×10^6/100 ml
Fecal Coliforms	55 to 110×10^6/100 ml

Source: Wanielista ,M. P., Y. A. Yousef, and W. M. McLellon, "Nonpoint Source Effects on Water Quality", Journal WPCF, March, 1977.

TABLE AII-61
EXISTING LAND USE[1]

DRAINAGE BASIN	RESIDENTIAL (Acres)	INDUSTRIAL-COMMERCIAL[2] (Acres)	AGRICULTURAL (Acres)	UNDEVELOPED[3] (Acres)
A	109	27	800	1,535
B_n	369	220	403	6,713
B_c	578	346	631	10,527
B_s	787	471	860	14,344
C	173	112	1,766	8,548
D	218	504	429	12,705
E	160	83	13	4,166
F	77	70	288	7,366
G	77	74	32	1,648
H	704	173	29	3,600
I	518	114	45	6,100
J	256	30	16	632
K	211	64	16	1,603
L	1,312	362	2,470	12,272
M	326	19	15	837
N	326	218	64	2,598
O	166	34	3	782
P	32	51	0	3,712
Q	346	30	0	1,058
R	10	45	0	1,302
S	3	0	45	1,424
T	1,306	16	0	144
U	0	122	0	922
V	0	141	0	576
W	3,366	67	0	3,485
X	435	8	0	1,016
Y	0	77	0	614

TABLE AII-61
EXISTING LAND USE[1] (Cont'd.)

SUB-BASIN	RESIDENTIAL (Acres)	INDUSTRIAL-COMMERCIAL[2] (Acres)	AGRICULTURAL (Acres)	UNDEVELOPED[3] (Acres)
Z	32	35	0	2,570
AA	10	6	12	1,048
BB	2	0	51	2,008
CC	26	13	179	1,702
DD	5,913	470	3	5,581
EE	435	22	0	554
FF	112	13	0	1,328
GG	339	35	45	3,024
HH	19	0	0	2,374
II	115	8	141	946
JJ	3	19	0	899
TOTAL	18,871	4,099	8,356	132,263

(1) 1975

(2) Includes Resource Production, Public/Semipublic & T.C.U.

(3) Includes Forested & Recreation

Source: Environmental Assessment Council, Inc.

TABLE AII-62
LAND USE UNDER THE PROPOSED ACTION - YEAR 2000

DRAINAGE BASIN	RESIDENTIAL (Acres)	INDUSTRIAL-COMMERCIAL[1] (Acres)	AGRICULTURAL (Acres)	UNDEVELOPED[2] (Acres)
A	109	27	800	1,535
B_n	1,177	511	352	5,665
B_c	1,795	767	528	8,992
B_s	2,448	1,045	720	12,249
C	320	992	1,530	7,757
D	294	513	429	12,620
E	198	88	13	4,123
F	314	70	288	7,129
G	186	115	19	1,511
H	941	180	38	3,347
I	678	186	45	5,868
J	307	30	13	584
K	384	64	16	1,430
L	1,811	576	2,470	11,559
M	557	17	13	610
N	416	237	64	2,489
O	454	40	3	488
P	32	55	0	3,708
Q	563	33	0	838
R	10	45	0	1,302
S	6	0	45	1,421
T	1,397	19	0	50
U	0	122	0	922
V	58	141	0	518
W	4,838	71	0	2,009

TABLE AII-62
LAND USE UNDER THE PROPOSED ACTION - YEAR 2000 (Cont'd.)

DRAINAGE BASIN	RESIDENTIAL (Acres)	INDUSTRIAL-COMMERCIAL[1] (Acres)	AGRICULTURAL (Acres)	UNDEVELOPED[2] (Acres)
X	691	10	0	758
Y	0	77	0	614
Z	32	35	0	2,570
AA	45	6	12	1,013
BB	13	0	51	1,997
CC	326	13	159	1,422
DD	6,592	621	3	4,751
EE	685	26	0	300
FF	1,088	16	0	349
GG	2,944	38	0	461
HH	256	0	0	2,137
II	768	31	6	405
JJ	64	26	0	831

(1) Includes Resource Production, Public/Semipublic and T.C.U.

(2) Includes Forested and Recreation

Source: Environmental Assessment Council, Inc.
Gannett Fleming Corddry and Carpenter, Inc.

Input required by the models included the storm event for which the assessments were to be performed and the acreages of residential, industrial/commercial, agricultural and undeveloped lands in each drainage basin. The required land use information for existing and projected conditions in the study area was given in Tables AII-61 and AII-62. The storm event selected for analysis was the 6-hour, 10-year storm event, that is, the 6-hour storm event that has a recurrence interval of 10 years. This is a fairly severe storm event, but it was decided to assess non-point source pollutant contributions from this adverse storm to determine the worst conditions that might be expected.

The Rainfall-Frequency Atlas of the United States* shows that the 6-hour, 10-year storm for Jefferson County is approximately 4.25 inches of rainfall. Non-point source pollution from rural areas is basically the result of erosion which will take place throughout the duration of a storm event. However, pollutant contributions from urban non-point sources come primarily from the washoff of accumulated organics, chemicals, sediment and other debris during the first stages of a storm event. Therefore, only the first 15 minutes of a storm event is considered in the urban runoff model EPAURA. To determine the rainfall intensity of the first 15 minutes of the design storm event, it was necessary to develop the hyetograph of the 6-hour, 10-year storm. The 4.25 inches of rainfall were distributed over the 6-hour period using accepted Soil Conservation Service practice**; results are shown in Table AII-63.

The Urban Runoff Model

As explained above, EPAURA determines the initial flush of pollutants from residential, industrial, and commercial acreage in a drainage basin during the first 15 minutes of the selected storm event. Five major parameters were assessed: BOD_5, Kjeldahl nitrogen, total phosphates, total solids, and lead. BOD_5 and Kjeldahl nitrogen represent the major oxygen-demanding pollutants washed into surface waters by rainfall-runoff. Phosphates along with nitrogen are the primary sources of nutrient enrichment of surface waters. Suspended and dissolved solids entering surface waters increase turbidity, which may have short-term adverse impacts on aquatic life. Lead is a heavy metal representative of chemical constituents in runoff from industrial and commercial areas. It is presently included on the list of regulated constituents under the National Interim Primary Drinking Water Regulations of the Safe Drinking Water Act, PL 92-523.***

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* U.S. Department of Commerce, Weather Bureau TP-40, Rainfall-Frequency Atlas of the United States.

** U.S. Department of Agriculture, Soil Conservation Service TP-149, "A Method for Estimating Volume and Rate of Runoff in Small Watersheds", April, 1973.

*** U.S. Environmental Protection Agency, "Manual of Treatment Techniques for Meeting the Interim Primary Drinking Water Regulations", May, 1977.

TABLE AII-63
TEMPORAL DISTRIBUTION OF 6-HOUR, 10-YEAR STORM FOR JEFFERSON COUNTY, ALABAMA

Time (hours)	Cumulative Rainfall (inches)	Rainfall Intensity (inches/hour)
1	0.27	0.27
2	1.73	1.46
3	3.36	1.63
4	3.83	0.47
5	4.07	0.24
6	4.25	0.18

Source: U.S. Department of Agriculture, Soil Conservation Service TP-149, "A Method for Estimating Volume and Rate of Runoff in Small Watersheds", April, 1973.

Gannett Fleming Corddry and Carpenter, Inc.

In EPAURA, non-point source loads are derived from loading factors, given in terms of pounds of constituent per curb mile for residential areas and pounds per impervious acre for industrial and commercial areas. The recommended loading factors are given in Table AII-64. Residential curb miles are calculated in EPAURA by an empirical formula which is a function of population density. An additional input required by the urban runoff model, therefore, is the population of each drainage basin; this information was given in Table III-25 of Chapter III.

The Rural Runoff Model

Non-point source pollution from agricultural and undeveloped areas is assessed in EPARRB by means of the Universal Soil Loss Equation. This rational formula calculates mass of soil loss per acre using the following six factors: 1) rainfall erosion index, a measure of the erosion potential of the design storm; 2) soil erodibility factor, a measure of the erosion characteristics of a particular soil type; 3) slope length factor, a variable to account for the effect the drainage path length has on the amount of sediment delivered; 4) slope gradient factor, a variable to account for the effect the drainage path slope has on the amount of sediment delivered; 5) cropping management factor, a measure of the effect of vegetation on sediment delivery; 6) erosion control practice factor, a measure of the effect of agricultural erosion control practices.

Using the temporal distribution of rainfall shown in Table AII-63, the rainfall erosion index was calculated and found to be approximately 31 for the 6-hour, 10-year storm. Fourteen soil groups have been identified in the study area, the dominant groups being the Hector-Montevallo and Minvale-Bodine-Fullerton groups. The soil erodibility factors associated with these fourteen groups are given in Table II-4 and the areal distribution of the soil groups is shown in Figure AI-6.

Slope lengths and slope gradients were estimated for each drainage basin using USGS 7.5 minute quadrangle maps of the study area. Cropping management factors of 0.26 for agricultural areas and 0.012 for undeveloped areas were specified, values used in previous applications of EPARRB by the Surveillance and Analysis Division of the EPA, Region IV.* It was assumed that erosion control practice on agricultural lands in the study area was not significant. For undeveloped land, the erosion control practice factor is not applicable. Therefore, this factor was set equal to unity for all rural acreage in the study area.

EPARRB makes several additional computations to determine the pollutant loadings to surface waters resulting from the erosion quantified by the Universal Soil Loss Equation. Generally, less than half of the soil eroded will actually reach surface waters. The percentage of eroded soil delivered is less for large drainage basins than it is for small drainage basins. The

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* True, Howard A., "A Gross Assessment of the Little Black Creek, Ga., Watershed Rural Runoff Annually, Wet Season and Under Selected Storm Conditions", USEPA, Region IV, Athens, Ga., July, 1976, unpublished.

TABLE AII-64
LOADING FACTORS FOR URBAN RUNOFF MODEL

	Residential (lbs./curb mile)	Industrial-Commercial (lbs./impervious acre)
BOD_5	2.0	8.72
Kjeldahl Nitrogen	0.5	1.13
Total Phosphates	0.26	0.52
Total Solids	430.	697.6
Lead	0.077	0.3226

Source: True, Howard A., "Non-Point Assessment Processes", April, 1976, unpublished, taken from Sartor, J.D. and G.B. Boyd, "Water Pollution Aspects of Street Surface Contaminants", EPA-R2-72-081, November, 1972.

relationship between sediment delivery ratio and drainage basin area has been derived empirically and this relationship was used to determine the sediment delivery ratio for each basin.* The soil loss is multiplied by the sediment delivery ratio in ERARRB to give the mass of eroded material expected to reach study area streams.

The sediment washed off rural acreage carries with it agricultural fertilizers, plant life litter, animal wastes, and other natural and man-made sources of BOD_5, nitrogen and phosphorus. To quantify these pollutant contributions, EPARRB calculates BOD_5, total nitrogen, and total phosphate-phosphorus as percentages of the total sediment load. The model also can calculate contributions from plant and animal life from input information on animal populations, forest litter production, and percent of undeveloped land which is forested.

While the soil loss computation can be made on either a storm event basis or an average basis for longer periods, the animal and plant life contributions can only be calculated by the rural runoff model for periods of a month or longer. EPAURA, the urban runoff model, assesses only storm events. Therefore, the combined use of the two models to analyze the total non-point source pollutant loading of a region is not possible without some adjustments by the model user. As described earlier in this appendix all analysis of non-point source pollution in the study area was done for a selected storm event. The percentages of oxygen-demanding pollutants in the sediment load recommended for use in the model were adjusted to reflect contributions from plant and animal life. The percentages of sediment load used for the major constituents were: 1) BOD_5 - 0.1%; 2) total nitrogen - 0.1%; 3) total phosphate-phosphorus - 0.08%. Contribution of heavy metals from rural areas is generally not significant, so lead was not included in the rural computations as it was in the urban computations.

EXISTING AND PROJECTED NON-POINT SOURCE POLLUTION

Modeling Results

Using the procedure described above, the existing non-point source pollutant contributions to study area streams from urban and rural runoff were estimated. The loads of each of five pollutants produced during the 6-hour 10-year storm event from residential, industrial/commercial, agricultural, and undeveloped areas were summed for each drainage basin of the study area and are given in Table AII-65.

For analysis of non-point source pollution under future conditions, 19 of 38 study area drainage basins were identified as those with the highest potential for stormwater-related problems. Basins that were projected to have significant land use changes or that already have a high percentage of developed land were included in the 19 basins modeled under year 2000 conditions. Results are summarized in Table AII-66.

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* Midwest Research Institute, "Methods for Identifying the Evaluating the Nature and Extent of Nonpoint Sources of Pollutants", EPA-430/0-73-014, October, 1973.

TABLE AII-65

EXISTING NON-POINT SOURCE POLLUTANT LOADS FOR SELECTED PARAMETERS - 6-HOUR, 10-YEAR STORM EVENT

DRAINAGE BASIN	BOD_5 (lbs.)	TOTAL PHOSPHATE-PHOSPHORUS (lbs.)	KJELDAHL NITROGEN (lbs.)	TOTAL SOLIDS (million lbs.)	LEAD (lbs.)
CAHABA RIVER					
A	675	4,700	4,705	5.875	3
B_n	1,040	3,470	3,515	4.345	22
B_c	2,365	11,325	11,390	14.160	36
B_s	2,880	12,715	12,810	15.905	49
C	2,465	17,225	17,250	21.530	12
D	1,265	9,900	9,995	12.380	50
E	480	2,015	2,030	2.520	1
F	940	6,015	6,030	7.520	7
G	350	1,170	1,185	1.465	7
H	945	3,575	3,610	4.470	19
I	635	2,460	2,485	3.075	12
J	150	500	505	0.625	3
K	435	2,125	2,140	2.660	6
M	150	1,060	1,065	1.330	2
O	180	685	690	8.470	4
P	300	1,355	1,365	1.695	5
Q	200	770	780	0.965	4
R	230	920	925	1.145	4
T	150	120	135	0.155	6
U	375	460	480	0.575	12
W	600	1,430	1,470	1.740	16
X	110	450	455	0.560	2
DD	2,020	2,985	3,120	3.760	63
EE	95	140	145	0.180	3
FF	125	705	710	0.885	1

TABLE AII-65 (Cont'd.)
EXISTING NON-POINT SOURCE POLLUTANT LOADS FOR SELECTED PARAMETERS - 6-HOUR, 10-YEAR STORM EVENT

DRAINAGE BASIN	BOD_5 (lbs.)	TOTAL PHOSPHATE-PHOSPHORUS (lbs.)	KJELDAHL NITROGEN (lbs.)	TOTAL SOLIDS (million lbs.)	LEAD (lbs.)
CAHABA RIVER (Cont'd.)					
GG	290	1,390	1,400	1.740	4
HH	170	1,330	1,330	1.665	<1
II	195	1,355	1,360	1.695	1
JJ	120	560	560	0.700	2
LITTLE CAHABA RIVER					
L	1,220	9,555	9,635	11.960	39
N	3,100	2,050	2,090	2.565	22
S	7,330	5,865	5,865	7.330	<1
V	530	150	175	0.190	14
Y	650	375	390	0.470	7
Z	2,060	1,575	1,585	1.975	3
AA	330	260	260	0.325	1
BB	2,770	2,215	2,215	2.770	<1
CC	3,885	3,080	3,085	3.855	1

Source: Gannett Fleming Corddry and Carpenter, Inc.

True, Howard A., "Non-Point Assessment Processes", U.S.E.P.A., Region IV, April, 1976, Unpublished.

True, Howard A., "A Gross Assessment of the Little Black Creek, Ga., Watershed Rural Runoff Annually, Wet Season and Under Selected Storm Conditions", U.S.E.P.A., Region IV, July, 1976, Unpublished.

TABLE AII-66
PROJECTED NON-POINT SOURCE POLLUTANT LOADS FOR SELECTED PARAMETERS - 6-HOUR, 10-YEAR STORM EVENT, YEAR 2000

DRAINAGE BASIN	BOD_5 (lbs.)	TOTAL PHOSPHATE-PHOSPHORUS (lbs.)	KJELDAHL NITROGEN (lbs.)	TOTAL SOLIDS (million lbs.)	LEAD (lbs.)
CAHABA RIVER					
B_n	6,965	4,545	4,645	5.690	52
B_c	11,060	7,305	7,455	9.145	77
B_s	17,580	11,910	12,120	14.910	109
H	3,620	2,505	2,545	3.140	19
J	660	460	465	0.575	3
K	2,605	1,955	1,970	2.445	7
M	615	450	455	0.560	2
O	715	475	490	0.600	5
Q	880	615	625	0.770	5
T	200	80	70	0.075	6
W	1,520	855	905	1.085	20
X	495	345	350	0.430	3
DD	5,170	2,600	2,775	3.285	80
EE	210	80	95	0.105	5
FF	330	195	205	0.245	4
GG	430	175	200	0.230	10
II	340	190	200	0.240	5
LITTLE CAHABA RIVER					
N	3,720	2,500	2,545	3.130	24
V	520	130	155	0.175	14

Source: Gannett Fleming Corddry and Carpenter, Inc.
True, Howard A., "Non-Point Assessment Processes", U.S.E.P.A., Region IV, April, 1976, Unpublished.
True, Howard A., "A Gross Assessment of the Little Black Creek, Ga., Watershed Rural Runoff Annually, Wet Season and Under Selected Storm Conditions", U.S.E.P.A., Region IV, July, 1976, Unpublished.

If the assumption is made that non-point source pollution in the basins not included in Table AII-66 would continue at approximately existing levels, then the percent change in non-point source pollutant loads from existing conditions to year 2000 conditions for the Cahaba River and Little Cahaba River watersheds may be calculated. If these comparisons are made, it can be seen that, overall, the Cahaba River watershed shows slight decreases in BOD_5, phosphate, Kjeldahl nitrogen, and solids loadings from existing conditions to the year 2000, while showing a substantial increase in lead runoff. The Little Cahaba River watershed shows small increases in all five parameters.

Given the limits of accuracy of the modeling done here, these changes in non-point source pollution loads are probably not statistically significant, with the possible exception of the large increase in lead in the Cahaba watershed. However, some further explanation of these trends is still in order, so that misleading conclusions are not drawn from these results.

As portions of the study area change from rural in character to suburban or urban, the nature of the pollutants in stormwater runoff from these areas will also change. Runoff from populated rural areas can be expected to carry significant amounts of eroded sediment and of nitrogen and phosphorus from agricultural areas and from plant and animal litter. Urban runoff can be expected to contain nitrogen and phosphorus, but more noticeably will contain oil, grease, and a variety of synthetic chemicals and heavy metals, such as lead, the indicator used in this analysis. Runoff from both urban and rural areas will contain a variety of biochemical oxygen demanding compounds. Thus, the fact that particular water quality parameters show no change or even some decrease in magnitude when comparing existing to projected conditions does not necessarily indicate a stable or improving non-point source pollution situation. Instead, the types of runoff parameters present may be changing - some increasing, some decreasing - in response to land use changes in the study area.

It should also be pointed out that the projected changes shown here in non-point source pollutant loads in the study area probably overemphasize the rural runoff contribution compared to the urban runoff contribution, due to the assumptions embodied in the models used. The rural runoff model EPARRB includes nitrogen and phosphorus from plant debris. However, this nutrient contribution does not enter solution directly, as the model implies, but only enters solution as the plant matter decays over time. Also, the rural runoff model calculates pollutant loads from erosion continuing for the duration of a storm event while the urban model calculates pollutant loads only from the first flush of a storm event. Thus, for a storm event of long duration, rural areas are likely to contribute heavier pollutant loads than urban areas. These assumptions should be kept in mind when comparing the results in Tables AII-65 and AII-66, especially for drainage basins in which the land uses are changing from rural to urban.

Potential Problem Areas

The results from EPAURA and EPARRB summarized in Tables AII-65 and AII-66 are, at best, highly simplified, order of magnitude estimates of non-point source pollutant loads to be expected during the adverse storm event analyzed here. Because of the large uncertainty associated with these estimates, drawing conclusions from the general trends shown by the modeling is preferable to viewing the results as exact quantifications. The nature of the mitigative measures appropriate for runoff-related problems also makes this approach preferable. Correction of existing stormwater problems can be expensive and difficult. However, if new developments in areas with high potential for non-point source problems are designed and built incorporating stormwater control measures, significant adverse impacts on surface waters may be avoided at lower costs than would be required to correct runoff problems later.

Several locations in the study area have the potential for non-point source problems in the future. The Trussville area is projected to experience continued residential, commercial, and industrial growth. The watersheds of Pinchgut Creek, Abes Creek and the Cahaba River in the Trussville area are likely to show changing runoff patterns. For this area, Tables AII-65 and AII-66 show some increase in the BOD_5 load from non-point sources, little change in nutrient or solids loadings, and probably some increase in heavy metals as indicated by the increase in lead shown for these drainage basins. In areas which change from rural land uses to urban land uses, it is not totally unusual to see this kind of decrease in nutrient concentrations, especially nitrogen, in runoff as the number of fertilizer and plant life litter sources are reduced.* Corresponding increases in the mass of heavy metals, grease, oil, and other types of urban debris being washed off to surface waters are likely in such regions.

The downstream portion of the study area is projected to be extensively developed in the year 2000. The watersheds of Patton Creek, Little Shades Creek, Dolly Brook and the Cahaba River downstream of U.S. Highway 280 are areas which may experience stormwater-related problems in the future. Analysis with EPAURA and EPARRB showed that the mass of BOD_5 and heavy metals reaching the Cahaba River in this area during storm events may increase, while nutrient and solids loadings will probably continue with little change.

The Little Cahaba River - Lake Purdy watershed will have little significant change in non-point source contributions to surface waters by the year 2000, according to EPAURA and EPARRB. Therefore, any water quality changes that occur in this watershed are likely to be the result of changes in point sources of pollution. The results given in Table AII-66 would seem to indicate that the continuing, long-term nutrient contribution to

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* Gannett Fleming Corddry and Carpenter, Inc., "Crabbs Branch Storm Water Management Study", prepared for Montgomery County, Maryland, Department of Environmental Protection, March, 1975.

Lake Purdy from rainfall-runoff will probably be as large, if not significantly larger, than the nutrient contribution to the reservoir from the Leeds wastewater treatment plant. However, direct comparison of nutrient loads from wastewater treatment plants and from runoff is not possible here. As discussed earlier, a large portion of the nutrient load estimated by EPARRB is nitrogen and phosphorus tied up in plant life litter. These nutrients can contribute to the eutrophication of the reservoir and to stimulation of aquatic plant growth in streams only over the long term, as the plant matter decays and the nutrients return to solution. Nutrients in the treated wastewater effluent are already in solution.

CONCLUSIONS

The assumptions, limitations, and purposes of this computer modeling analysis should be kept in mind when examining the results shown in Tables AII-65 through AII-66 and in the description given above. The detailed point source pollution analysis in Chapter 5 and Appendix II of the EIS is primarily in terms of dry weather, low streamflow conditions. On the other hand, the non-point source analysis refers primarily to wet weather, high streamflow periods. Although the point source and non-point source problems are not completely independent, it is likely that only one of these pollutant contributions exerts its maximum influence on area streams at any given point in time. During dry periods, surface runoff contributions are minimal, as evidenced by the low background levels of pollutants seen in the dry weather water quality data collected by Barton Laboratory of Jefferson County for the Birmingham Regional Planning Commission 208 Study. Point sources are, under such conditions, the primary cause of any dissolved oxygen deficits that occur. During periods of significant rainfall-runoff and high streamflow, the adverse impact of point sources on the dissolved oxygen content of area streams is significantly reduced, as can be concluded from the water quality modeling results for streamflow augmentation alternatives given in Appendix II. Therefore, the selection of the appropriate wastewater conveyance and treatment facilities is not directly dependent on this non-point source pollution assessment.

In addition to streamflow conditions, antecedent rainfall conditions will affect the impact non-point source pollution has on area streams, especially in urbanized areas. Not every storm of a given intensity and duration, including the storm analyzed here, will always produce runoff with the same characteristics. The length of time between storm events affects the mass of pollutants that accumulates and the pollutant concentrations in subsequent rainfall-runoff.

With these caveats in mind, one can conclude from the modeling results that there will be storm events that adversely impact the quality of area streams on a short-term basis, in terms of both oxygen-demanding substances and other contaminants. The 19 drainage basins listed in Table VII-66 have the greatest potential for such problems. In addition, problems with respect to quantity of runoff may develop in these drainage basins; these are described in Chapter 5 of the EIS. Any stormwater management strategies developed in the future should concentrate on these areas.

Some stormwater management techniques have been described in Chapter VI of the EIS. It can be seen that many runoff control measures are integral parts of proper land use planning in new residential, commercial, and industrial developments. Thus, stormwater management should be a continuing concern of local planning authorities.

In summary, the following conclusions can be drawn from this analysis of non-point source pollution in the study area:

1) Rainfall-runoff may adversely impact the quality of some area streams on a periodic, short-term basis.

2) The potential for stormwater-related problems is significant in 19 study area drainage basins that have been identified in this appendix.

3) The most significant change in quality of runoff from developing drainage basins may not be in the mass of pollutants produced, but in the types of pollutants produced. Developing areas will show increases in contaminants of an urban origin, such as oil, grease, and heavy metals, and a decrease in rural pollutants, such as fertilizers, plant litter, and sediment.

4) The contribution of nutrients to Lake Purdy from non-point sources will probably not change significantly by the year 2000.

5) The resolution of the wastewater treatment facilities issue appears to be independent of resolution of the stormwater management problem.

6) Management of study area stormwater problems is closely tied to land use issues and is best handled in a continuing planning context. The Birmingham Regional Planning Commission's study under Section 208 of PL 92-500 has begun this planning process.

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